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Robo hand car to monitor the health of the tracks in railways

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***Abstract*---**Transportation plays a major role of a person's life. A life without transportation is unimaginable. People focus on four major types of transportation i.e. Roadways, Railways, Airways and Waterways. Among these transportation majority of people prefer railways as it helps connect distant locations and the comfort it provides. But the problem in railways is it needs more of monitoring and thereby the person travelling across areas can be at ease. In order to ensure safety in railway transportation, monitoring of tracks is very crucial. Hence, this research article focuses on monitoring the tracks present in railways through a novel image processing technique devised. The name of the technique we devised is known as CRACK TRACKER. Crack Tracker does the role of monitoring the tracks by capturing the images of the tracks and it is sent to the nearby station so that the cracks can be patched in the future. The cracks are clearly detected and intimated instantly to the station master. A reliable solution for continuous and cost efficient tracking is processed and depicted in this research article.

***Keywords*---**Track Monitoring, Image processing, Crack Detection and GPS Response.

Introduction

In most developed and developing countries, railways are a massive network. It connects all states and makes inter-state trade and bear a large number of passengers. It is the world's second largest rail network which transports almost 2.5 crore passengers daily. While travelling the government ensure the safety measures of the people. The measures are adopted by the government are to monitor the railway track relentlessly, prevent the signal failure, provide proper information to the gate keepers concern the arrival of train. Most of the railway accidents are happened due to crack in the track and signal failure. The government ordered the people to wear helmet but it did not realize that majority of the accident caused due to large hole and worse condition of the road. Like that, monitor of the track play a vital role in the railway department. It has a route length of 95,981 kilo meter. In the year between 2009-10 and 2014-15, there was a total of 803 accidents in Indian railway. 47% of these accidents were due to derailment of train. Derailment is caused due to track and expansion of the crack.

Related Works

To confine the related works of track monitoring and health of the track various researchers have provided multiple innovative solutions. In [1] IR Sensor is used to detect the crack in the railway track and Bluetooth is used to send the responding signal to the server. In [2] various sensors are used to monitor the vibration and variation of the track. But it is less efficient. In this model time consumption is more because the collected data by the sensor transfer to the server which decodes the data. In [3] again an IR Sensor is used to detect the cracks and the GSM receiver triangulate the position of the vehicle to receive the latitude and longitude. In [4] proximity sensor is used to detect the obstacle, which interfere the movement of rail. In [5] Heat sensor is used to detect the temperature, because expansion of track during summer is often. Heavy rain detection system setup is formed to detect the fore coming weather. In [6] crack sensor and IR sensor is used. The IR sensor senses the voltage variation from the crack sensor. It is high power consumption and complex structure. In [7],[8],[9] and [10] the researchers emphasized on the structure of the tracks through analytical health analysis.Even though multiple solutions are provided problems have been identified and based on this the proposed method model is created. The proposed method uses an USB PI Camera to detect the minute crack and monitor the track efficiently. On board chip send the alert message to the server using Wi-Fi unlike Bluetooth; it is used for longer distance. GPS is used to receive the coordinate and it is more accurately than GSM. Use metal hand striker to strike the obstacle and resume the movement.

Proposed Method

The proposed block diagram is given in Figure 1. It depicts the overall system flow happening in the field side and control side.

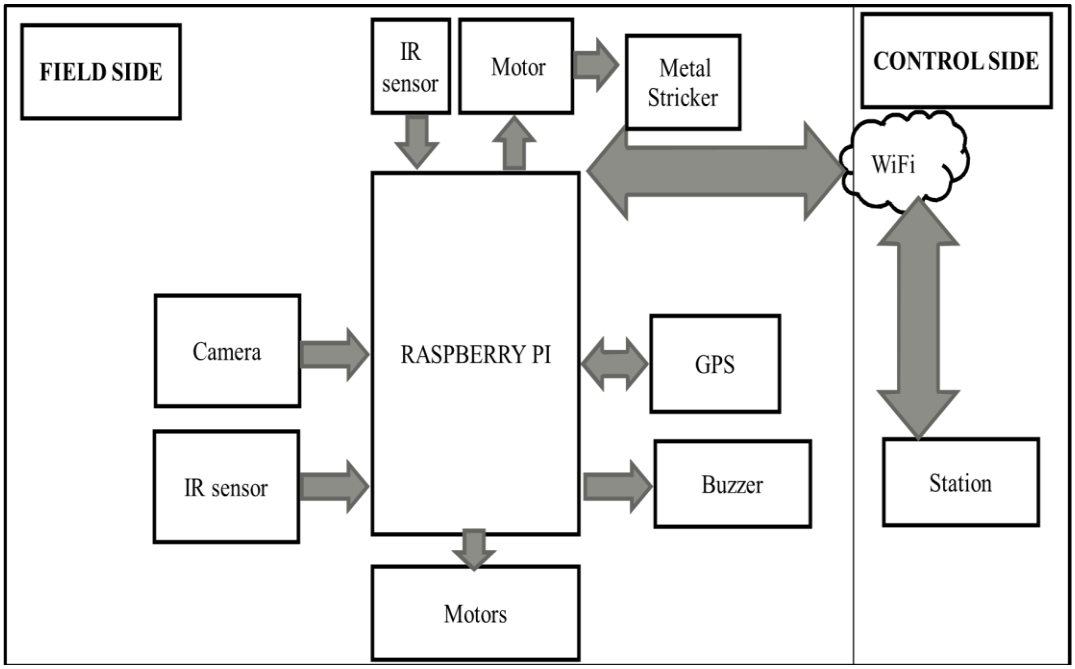

Figure1: Block Diagram of Crack Tracker

In this model, a Raspberry pi 3 model b is used to get the data's from camera, IR sensor. Here USB 2.0 camera is used to capture the image. Since the 8 line parallel bit camera is more sensitive in wiring the USB camera is used. Two IR sensors are used to remove the obstacle. One from exactly on the railway track and other from between the railway tracks. In this manner IR sensors are placed. Captured image are processed through processor (raspberry pi) to detect cracks on the tracks. The maximum delay for capturing and processing the image is 5 seconds. And then here neo 6m GPS is used to send the coordinates of cracked track area. Buzzers are used like Horn, if there is any obstacle is crossing the track buzzer sounds. The metal striker an ordinary metal is connected to a motor shaft to eliminate the obstacle like stones on the railway track. Here aluminium metal is used as metal striker. Since it is weight less and strong it can be easily it can be rotated with the motor. The coordinates generated by the GPS is stored in the cloud which can be viewed on the server side. The vehicle movement is controlled by the operator on the server side through Wi-Fi connected. Hence, in the control side only Wi-Fi connected phone or laptop is enough to control the Crack Tracker.

Test Cases:

The working methodology considers four test cases and they are represented through figures 2,3,4 and 5.

Case-1:

In case of minute cracks, corresponding coordinates are transmitted to the cloud and stored and it moves forwards, repeats the initial condition.

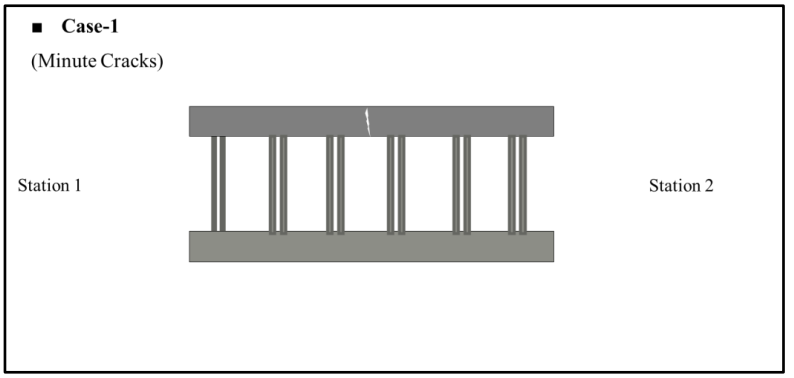

Figure 2: Minute crack

Case-2:

In case of large crack (Fissure), the hand car stops and transmits the coordinates and then it moves reverse direction to reach the same control field.

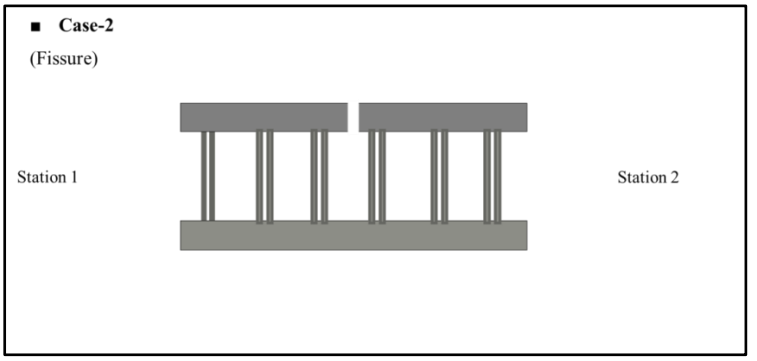

Figure 3: Fissure crack

Case-3:

In this case an obstacle is placed on the railway track which is sensed by the IR sensor 1 and actuates the metal striker to remove the obstacle.

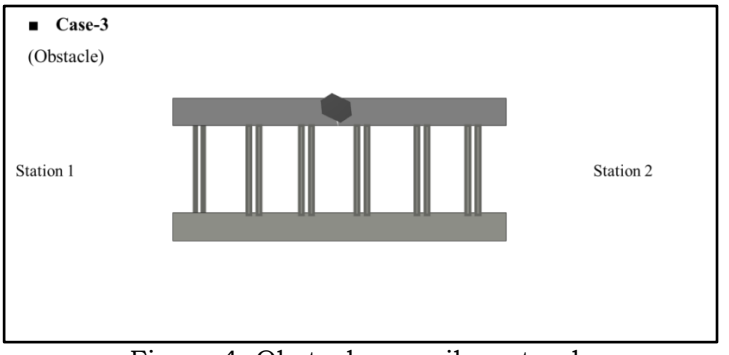

Figure 4: Obstacle on railway track

Case-4:

In this case a human is crossing through the track, hence it can be sensed by the IR sensor-2 and alerts by buzzer.

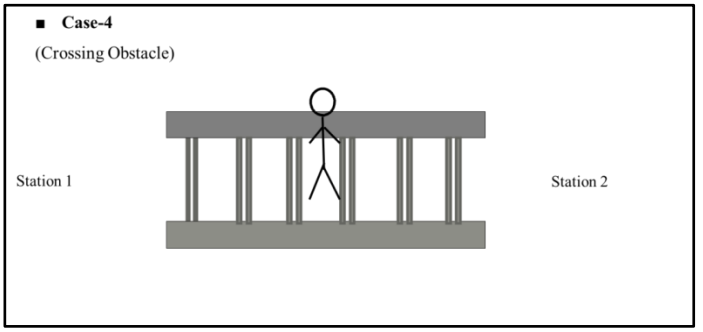

Figure 5: Crossing Obstacle on the tracks

Experimental Results

From the representation of the Crack Tracker as shown in Figure 1, for every 4 seconds the camera captures the track of length 7 cm. The 4 seconds delay is due to the processing image takes 4 seconds to tell whether the captured track image has crack or no crack. We have captured many tracks and processed on our code. It distinguishes the image correctly as crack and no crack. In Figure 6, we can see the database of railway track images.

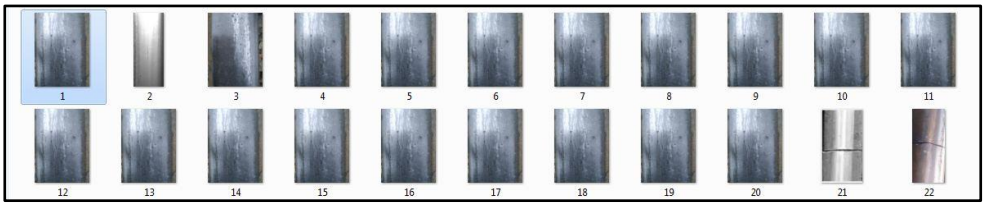

Figure 6: Sample Database of railway track

In Figure 7, healthy track with commenting an output of “No crack” is shown, which takes four seconds to process on. If there is no crack on the track in continues to move for a second and stops and then it captures the image and goes on.

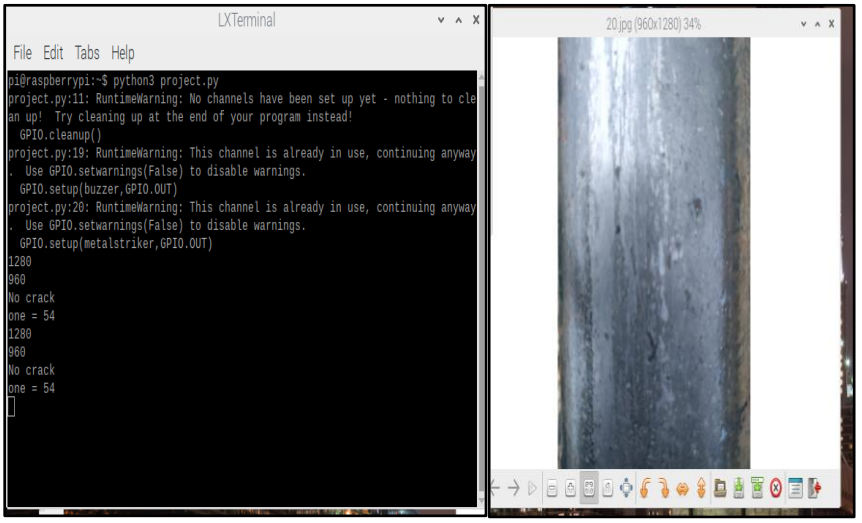

Figure 7: Results of No crack track

In Figure 8, the cracked track with commenting “Crack is detected” and “sending current co-ordinates” is shown. And this takes on to a further condition that, if it is a large crack it sends the co-ordinates (i.e.) latitude and longitude to the cloud and moves backward and reaches the station 1. And if it is a minute crack it sends the co-ordinates and moves further towards the station-2.

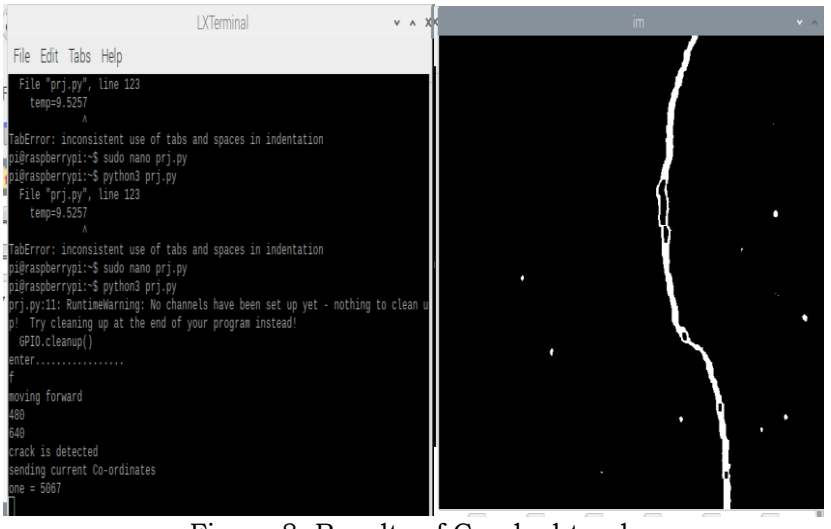

Figure 8: Results of Cracked track

Finally, the GPS output latitude and longitude is stored on the cloud (Thing Speak) with time stamping and using this we can locate the exact location of the cracked track area. The Cracked Track area locations are send to the nearby station master and further steps are taken to repair the track.

Conclusion

The Railway health monitoring through the CRACK TRACKER is more efficient and economical way to monitor the health of the railway tracks. Also another advantage is monitoring through image processing makes the detection for accurately than any other IR sensor or ultrasonic sensor. Thereby this leads to reduction of accidents due to the rail track failure and dislocation of those tracks.

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