BANGLADESH UNIVERSITY OF PROFESSIONALS (BUP)

Project Proposal

Tentative Title: Automated Railway Crack Detection

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<tr><td>4.</td><td>Title of the Project:</td><td></td><td>Automated Railway Crack Detection</td></tr>
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<tr><td></td><td>• Name of the University</td><td></td><td>Bangladesh University of Professional</td></tr>
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I. INTRODUCTION

Railway is one of the most significant domestic transports that links the length and breadth of an entire country. In Bangladesh, railway transport is most widely and commonly used and this is the cheapest mode of transport for the local people. But it is a matter of great sorrow that, railway tracks of our country are very prone. That's why, a vast number of accidents occur every year due to this primitive type of railway tracks and as a result of those accidents we lose a huge number of lives every year.

Though Bangladesh Railway is stated as one of the safest transportation systems, its service condition and improvement status may not go with the statement. Since 1972, Bangladesh has been going through a large number of train accidents. These days we can observe frequently in the news that railway accidents are rather common. According to Arthur D. Little groupings, 20% of all rail accidents occur due to broken rails. From 1998-2012, 4666 train accidents occurred of which 4287 were due to derailments. Almost 92% of overall accidents are caused by derailments which show its frequency is quite high [1]. These huge rates of derailments involve significant economic losses, interruption to services and obviously the safety risk of passengers. The main drawbacks behind this reason is the lack of obligation and the inappropriate management in the operating system by the authority. Analysis of train derailments in Bangladesh railway, shows that 72.6% (2195 out of 3022) of derailment was occurred because of the defects of track when 15.5% due to human failure, 7.1% due to vehicle failure, 4.8% due to combined factors and remaining 0.1% due to others [2]. This is the reason to automate the train maintenance system over the manual and human dependent present one.

Table-I: Statistics of the Number of Casualties Caused Due to Train Accidents

Year July-June	Number of Train Accidents	Number of Deaths/Injuries	Number of Train Derailments
2013-2014	177	185	158
2014-2015	312	246	292
2015-2016	166	36	123
2016-2017	80	10	44
2017-1018	94	52	64
2018-2019	91	56	78

The main reasons behind the creation of cracks on a railway track include movement of heavy vehicles (both trains and cars) on the railway tracks. So, a country like Bangladesh is more likely to have this railway problem . These cracks or disturbed railway parts can be checked manually by traveling the railway track on a trolley car. But the manual process is time worthy and human error can occur so that cracks can be gone unnoticed. So, we need an automation system so that any accident due to railway cracks can be avoided.

This project will be a milestone in the way of preventing railway accidents in the mentioned ways:-

- ☐ The train will be able to automatically detect the crack on the railway track from a safe distance.

- After the detection of a crack or any kind of fault, the train will receive a red light alert . The driver then can know about the upcoming danger.

But only a red light alert is not enough. Because the drivers sometimes fall asleep or miss the signals due to fog or unawareness. So, this project includes the system to stop the train automatically when any problem is detected. So, the lives of the passengers will not depend on any wrong decision of the driver.

So overall, the main objectives of this project would be:-

- To determine the existence of any crack on railway track
- To give light signal and stop train automatically in the presence of railway cracks

II. Literature Review

Many approaches were proposed to be implemented for monitoring of the whole rail track system. Due to the harsh climate situation on the Qinghai-Tibet railway, conducting a real-time monitoring system has proved difficult. “A real-time rail track monitoring system with precise point positioning (PPP), and the geographical information system(GIS) to support the development, analysis, and visualization of real-time spatial and attribute data sets”, have been brought forward to solve the crisis. But this system requires a long initialization time, which limits its real-time potential [4]. The development of the “probe-vehicle” system was another brilliant invention for conducting advanced railway condition monitoring. In this system, rail corrugation is estimated using vibrations and noise signals. The system detects the corrugation and irregularities and then the GPS and map matching algorithm localizes the fault on track, which results in the effective estimation of rail corrugation and irregularities. Although it is highly accurate and easy to implement, it is noise sensitive [5]. Another method

presents the interaction between wheel/rail to monitor rail corrugation growth detected on sharply curved tracks, to prioritize track maintenance. Rail corrugation developing on the low rail in sharp curves after extensive use is a problem experienced by many railway networks worldwide. This method is performed as part of a project, which helps to develop a numerical tool for the prediction of rail corrugation growth on curves [6]. Derailment of trains is one of the major causes of railway accidents. Misalignment of tracks due to loosened fishplate generally causes this. To fix this issue, a real-time fishplate monitoring system has been proposed which detects any rotation of bolts and sends an accurate location to the central railway monitoring center through its GPS. It even works in remote areas as long as a 2G network is available and is cheaper than most other alternatives. The only drawback to using this system is that it only detects loosened bolts [7]. In a different paper, a digital image-based system was proposed which took 3D images. These images were analyzed to detect corrugation on the tracks. Although it allowed real-time monitoring. It wasn't very precise at high speeds [8].

In this paper, an IoT-based real-time automated system is proposed that can detect cracks on a rail track and send its location to the concerned authority. Due to the change of seasons, the rail tracks may weaken because of constant expansion and compression. Also, Bangladesh does not have specific tracks for each type of train. So, trains that transport goods run on the same track as passenger trains. Because of that, the tracks are more prone to fracture. Detecting this misalignment of tracks can lead to lesser accidents. In this proposed system optical fiber and GPS has been used to detect irregularities on the tracks. If it detects any irregularities, it will alert the railroad signal changing its color to red. This system functions as a permanent monitoring system by raising warnings as soon as the railroads are misaligned and thus preventing accidents.

III. METHODOLOGY

An optical sensor is mounted on the front of the train. It sends out light rays and receives them once they bounce back.

We use a microcontroller board connected to an optical reflective sensor, LED light and motor driver. If the sensor detects an obstacle, it signals the LED light to glow red and the motor driver to stop.

Component Description:

A. Optical Sensor: An optical sensor converts light rays into an electronic signal. The purpose of an optical sensor is to measure a physical quantity of light and, depending on the type of sensor, then translates it into a form that is readable by an integrated measuring device. Optical sensors are used for contact-less detection, counting or positioning of parts. Optical sensors can be either internal or external. External sensors gather and transmit a required quantity of light, while internal sensors are most often used to measure the bends and other small changes in direction.

B. Arduino Uno: After getting the signal from the ultrasonic sensor is fed into the Arduino Uno. A motor driver and LED light are also connected with it.

C. LED display: A display shows a red light immediately after getting a signal from Arduino UNO.

D. Motor Driver: A motor is used to run the train. A signal from the microcontroller can stop it.

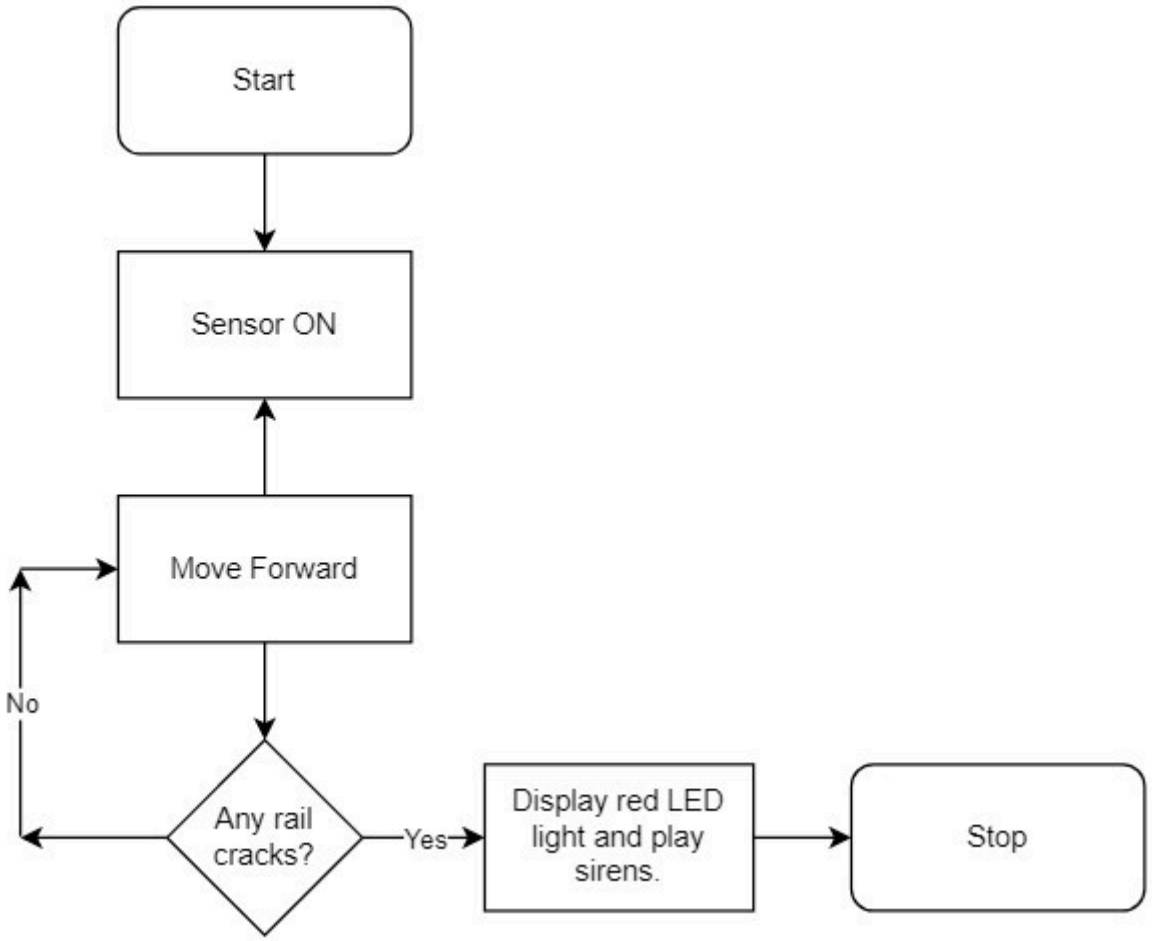

Figure 1 : Process Flowchart

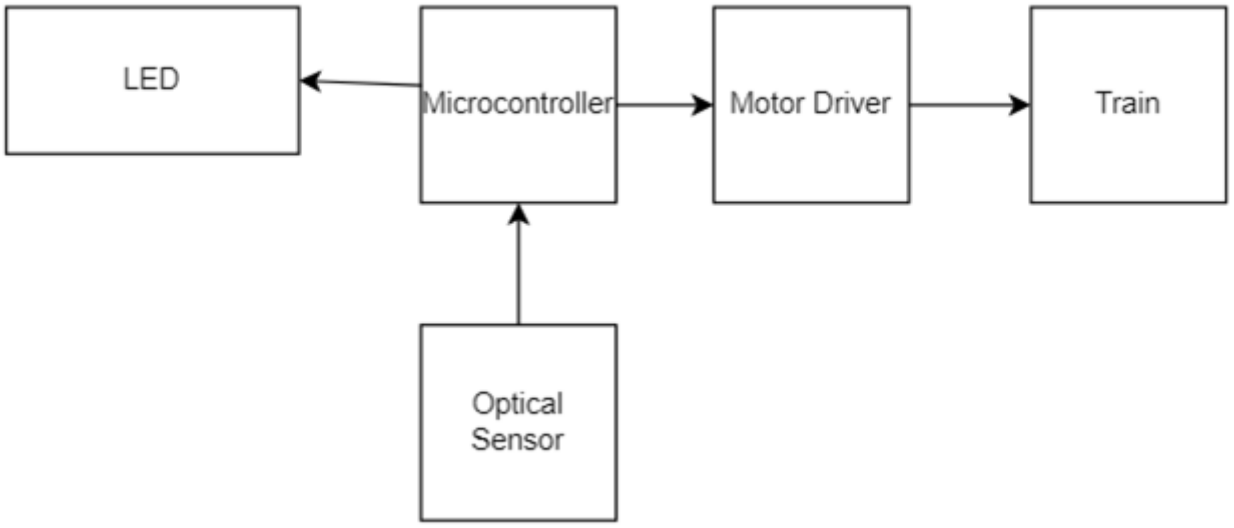

Figure 2 : Circuit diagram of system design

We use reflective sensors here. Transmitter and receiver are stored in the same housing. A light beam is reflected on an obstacle and returns back to the receiver. The limitations of this setup are that depending on the size of the crack, the reflected beam might be angled too high or too low and that it can only detect upward cracks or bends in the railway.

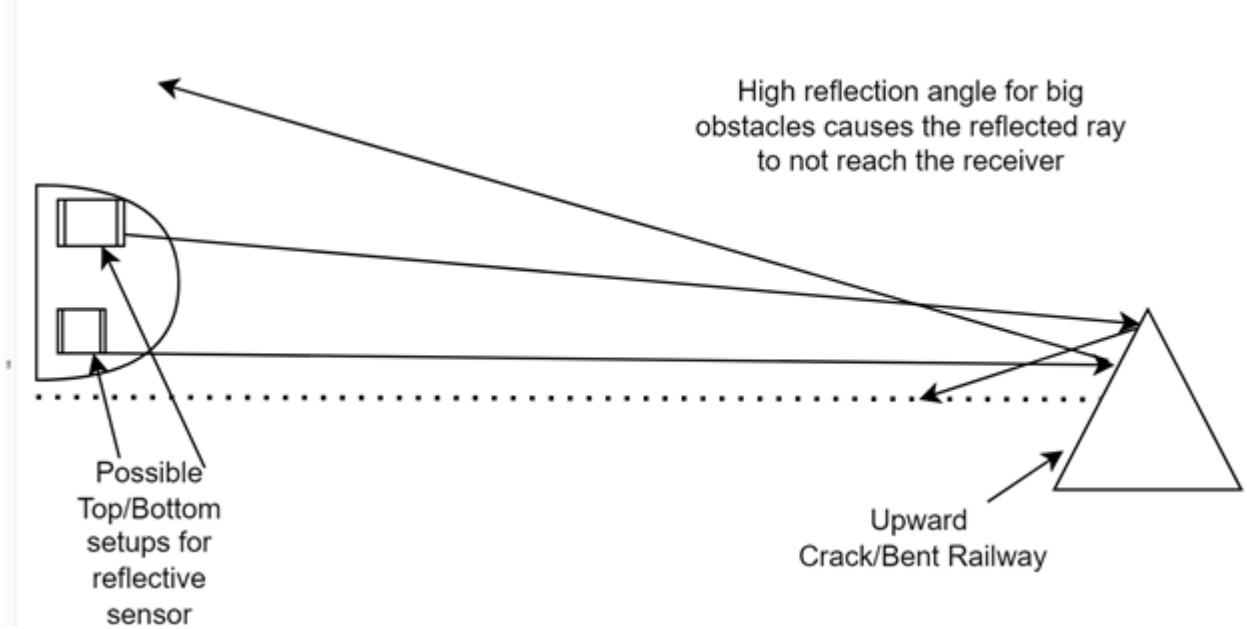

Figure 3 : Working Method of the Proposed Model.

IV. Description of the work plan of two months:

This project is divided into multiple stages that are interrelated with each other in a top-down approach. At first, previous projects with similar objectives will be studied. This will take approximately two weeks. Then the collected data will be compiled in the project. A week will be allocated to equipment collection. Building the model takes the largest amount of time, so 3 weeks will be allocated to it. After the development of the model, the results will be reported. The final preparation of the report may take one week of time.

Table-1: Weekly work plan for the project

Work Plan	Weeks							
Research on Previous Projects								
Compilation of the Proposal								
Equipment Collection								
Model Development & Reporting								
Final Project Submission								

References:

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