SMART SOLUTION FOR RAILWAYS BASED ON IoT

Submitted by PNT2022TMID47359

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING
in

ELECTRONICS AND COMMUNICATION ENGINEERING

GOVERNMENT COLLEGE OF ENGINEERING -SRIRANGAM

NOV 2022

ANNA UNIVERSITY :CHENNAI

BONAFIDE CERTIFICATE

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CONTENTS

Test Cases
 User AcceptanceTesting

 9. RESULTS
Performance Metrics

10.ADVANTAGES &DISADVANTAGES
 11.CONCLUSION
 12.FUTURE SCOPE
13. APPENDIX
         Source Code
       GitHub & Project Demo Link

1.INTRODUCTION

1.1 PROJECT OVERVIEW

Railroad track is known a stable structure that mainly consists of rail sleepers, fishplates and fasteners. It ensures the transportation of trains through providing a dependable surface for their wheels.This sensor is used for easy and accurate detection of cracks developed on the surface of concrete structures due to deterioration. The sensors are previously bonded onto a concrete structure and the wirings are finished. Infrared transmitter is one type of the LED which emits infrared rays generally called IR transmitter. Ultrasonic sensor is used to detect the crack in the rail track with measuring the distance from track to sensor. Ultrasonic technique is the most effective method which detects cracks on a railway track.Abstract-In India railways transportation service is the cheap and the majority convenient mode of passenger transport and also for long distance and suburban traffic. The main cause of the accidents happened in railways are railway track crossing and unrevealed crack in railway tracks. Therefore, there is a need to have new technology which will be robust, efficient and stable for both crack detection in railway track as well as object detection. This project discusses a Railway track crack detection using sensors and is a dynamic approach which combines the use of GPS tracking system to send alert messages and the geographical coordinate of location. Arduino Microcontrollers used to control and coordinate the activities of this device. Keywords-GPS Module; Arduino Microcontroller; Railway Track In previously existing system, the work is to be done manually, but the proposed system has a robot which will run automatically on the tracks. System having LED and LDR sensor assembly, but the main disadvantage is that the LED and LDR must be placed opposite to each other and also the environment needs to be perfect to detect the track. To

overcome this.Railway is one of the most significant transportation modes of our country 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 are occurred every year due to this primitive type of railway tracks and as the consequences of those accidents we lose huge number of lives every year.These types of incidents motivate us to think over the above mentioned issue and take necessary steps to protect those lives. Through our proposed system, we need to establish more modern and secure railway system. Besides this, there is no such type of technology or system in our country which can stop the collision between two trains coming from the opposite direction of each other on the same track. We actually think over this matter and motivated to do so. Moreover natural disaster can throw any object on the rail track which cannot be removed very quickly in the remote area. We thought if our system can detect those object or barrier and inform to the control room then they can take necessary steps 3 to avoid accident. Figure1 depicts the crack on track. The Rail transport is growing at a rapid pace in India. It is one of the major mode of transport but still our facilities are not that accurate, safer as compared to international standards. A survey on the internet states that about 60% of all the railway accidents is due to derailments, recent measurements shows that about 90% are due to cracks on the rails. Hence, it is not safer for Human Life. This needs to be at the utmost attention. These goes unnoticed and the properly maintenance of tracks is not done.

1.2 PURPOSE

The proposed railway track monitoring system will automatically detects the crack in the railway track and obstacle without any human intervention.Surveying and mapping activities flourished in the United States as people began moving inland over the inadequately mapped continent. The settlement of the frontier, the development of agriculture, and the exploitation of natural resources generated a demand for new ways to move people and goods from one place to another. Privately owned toll or turnpike roads were followed first by steamships on the navigable rivers and by the construction of canals and then in the 1830s by the introduction of railroads for steam-powered trains.While rail transport can be a great solution for many shippers, it isn"t for every load. There are some limitations to consider. First, the shipper and the consignee should be no more than 100-200 miles from a major metro area that has a terminal. Also, there aren"t guaranteed transit times, so it"s not recommended for time-sensitive loads. You also want to make sure that you aren"t trying to ship prohibited or restricted articles. Prohibited articles include commodities that are dangerous or could damage equipment, like carbon black, raw animal hides, and used auto parts that leak.

Restricted commodities require permission ahead of time and may be constrained to certain lanes or subject to different pricing. In addition, it"s incredibly important that you are using the proper block and brace techniques. Intermodal containers experience a great deal of movement during transit that could cause damages. If you haven"t blocked and braced your freight by rail standards you run the risk of a denied claim.

2.LITERATURE SURVEY

2.1 EXISTING SOLUTION

Abstract: Safety and reliability are considered in one of the main issues at all transport system, particularly in railway. An automatic railway track crack detector system for Railway has been proposed here which aims in building a robot that can detect and analyze any kind of crack on the railway line and send the coordinates of that faulty line to the concerned authority. The proposed system can be networked with multiple robots and central computer system can control all these robots, so that complete track can be scanned for detecting any crack before each time train passes through track. Multiple such systems can be connected by using LoRa network instead of GSM network. This will eliminate the connectivity and network traffic issues. With the networked robotic system can be connected with the railway signaling system to synchronize the signaling with the crack detection. Synchronization with the signaling system can help automatic control of traffic if any crack is detecte.Over the years many researchers have tried to build up a system for tracking the cracks in rail lines. Krishna used IR technology to track the cracks and send it through the Bluetooth. Though Bluetooth system is not effective for long range communication. Some researchers used IR transmitter and receiver for railways crack inspection and send the data through GSM module. However, sometimes the IR sensor can detect a small crack which might not be that risky for trains and cause an unnecessary concern. Muley et al proposed an opamp based system where the crack has been identified by the change of output voltage in the op-amp . Though a noise in the railway tracks can change the voltage and give a false alarm. Rizvietal and Delforouzi et al uses a computer vision based railway crack detection system. It"s an effective method to inspect the cracks. However, to detect the cracks in the night it needs high functioning cameras, which increase the cost of the system. There are also some other systems exists to solve the crack problem using different sensors, Zigbee technology and LED-LDR system. But most of this system is designed for other countries rather than Bangladesh. Safety and reliability are considered in one of the main issues at all transport system, particularly in railway. There is a view from the experts that the present regulatory framework does not clarify effective deal with railway accidents and derailments, approximately 60% of a rail

accident is due to the derailment, of which 90% are due to crack problems. In recent years developing country like Bangladesh needs more diversification and innovation in the transportation system. With the increasing number of the population the current safety framework needs to be equipped with safety legislation and more invulnerable. Safe railway track plays a significant role to carry more than sixty thousand people at a time. Therefore, a consistent system is required to detect the cracks in the railway tracks.

II. MOTIVATION

Though a noise in the railway tracks can change the voltage and give a false alarm. Rizviet al and Delforouzi et al uses a computer vision-based railway crack detection system. It"s an effective method to inspect the cracks. However, to detect the cracks in the night it needs high functioning cameras, which increase the cost of the system. There are also some other systems exists to solve the crack problem using different sensors, Zigbee technology and LED-LDR system. But most of this system is designed for other countries rather than Bangladesh. In this project, for the first time in Bangladesh, a cost-effective autonomous railway crack detector robot is proposed for Bangladesh railway. This device can generate a complete solution for the railway track that starts with crack detection, fault analysis using ultrasonic sensor and that end up with an SMS alert to the concerned authority which consists of the location of the crack. Therefore, making ease the authority to prevent accident san extra communication with the help of a Relay in between the terminals which thereby enhances the signal quality.

2.2 REFERENCES

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2.3 PROBLEM STATEMENT

Although the development of railways in our country took place rapidly, still there are numberless problems in the path of steady growth.

The main problems are stated as under:

1.Old Track and Poor State of Rolling stock;

The major problem faced by Indian railways is that the tracks are old and outdated. These old tracks cause many serious railway accidents. This has also resulted in speed restrictions. Virtually, every new timetable, running time of all trains has been increased while railways in other advanced countries are reducing it drastically.

2.Travel without Tickets:

Another problem that is being faced in India is that a large number of passengers travel without purchasing tickets. Indian railways have to bear extra loss of about Rs. 5 crore every year on account of traveling without tickets

3.RailwayAccident;

The incidence of railway accidents in our country is greater as compared to other countries of the world. Accidents occur due to the errors and negligence of the employees.

1. Attack on Railways:

The Indian railways had to suffer a heavy loss of crores of rupees. The railways are attacked during the time of disturbances and violence‟s that arise in any part of the country. For instance, there was heavy loss of railways in the movements of West Bengal, Telengana and Assam etc.

2. Lack of Modern Managemen

There is a lack of modern management as railway failed to attract adequate incentives and suitable talent. In addition to it, it could not make economic analysis for perspective planning tariff.

3. Outmoded Technology: The rolling stock technology is absolutely outmoded. The system is beset with excessive man-power and manpower development has not kept pace with technology up gradation. This has made railways incapable of coping with increasing transport demand and of raising and improving the traffic volume and flows at lower unit cost of operation.

4. Problem of Replacement:
The problem of replacement of old and obsolete railways engines, wagons and other equipment has created a serious problem in India.

5. Problem of Laying Double Lines;
Most of the railway lines are single lines which create great inconvenience to the railway organization and passengers.

6. Inadequate Investment:
The railway transport has lagged behind the requirement The shortcoming has been highlighted by different committees, The National Transport Policy Committee, The Rail Tariff Enquiry Committee and The Railway Reforms Committee.

7. Competition with Road Transport:
The competition with road transport is growing in intensity, both in passenger and in goods transport. The lack of coordination between railways and road transport has lowered the earning capacity of the railways

This has further caused delay in traffic movement and inconvenience to passengers. Therefore ,railways plays important role in today"s economy and there are numerous problems to in this concern we need to create solution for a most important problems that railway department mainly concerns and need to rectify.

3.IDEATION AND PROPOSED

3.1EMPATHY MAP CANVAS
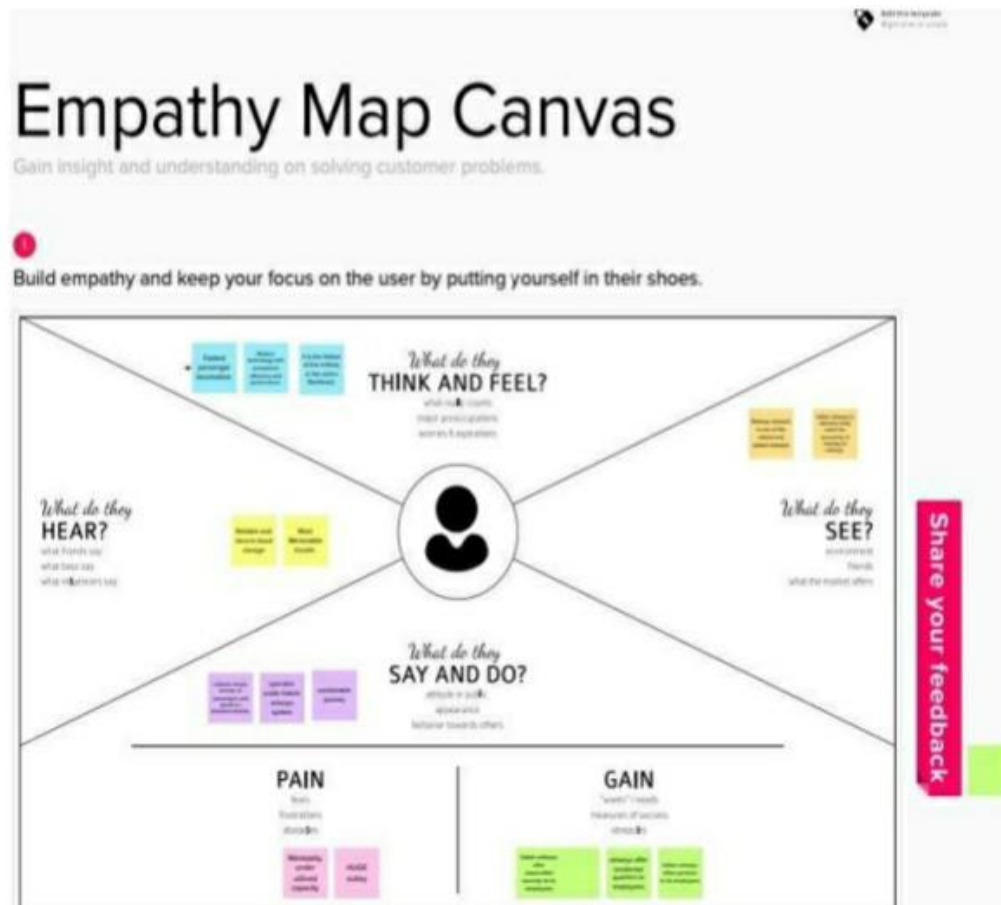
3.2 IDEATION AND BRAINSTORM

3.3 PROPOSED SOLUTION

Proposed Solution Template

Project Team shall fill the following Information in Proposed Solution Template

S.No	Parameters	Description
1	Problem statement (Problem to be solved)	Rail options provide you with access to capacity.
2	Idea/solution Description	Automatic railway gate control , Railway track crack detection, Driverless train system
3	Novelty/Uniqueness	Transport via railways is economical,quicker and best suited for carry heavy and bulgy goods over long distances.
4	Social impact/customer satisfaction	Instigate the development of social economic and environmental territory around their location.
5	Business Model (Revenue model)	Day by day project will be demantbin market hence growth will be best
6	Scalability of the solution	Good as working application at all condition

3.4 PROBLEM SOLUTION FIT

3.4 PROBLEM SOLUTION FIT

Define CS, fit into CC	1.CUSTOMER SEGMENT(S) Citizens and peoples	6. CUSTOMER CONSTRAINTS This reduction of time for which the gate is being kept closed .	5. AVAILABLE SOLUTIONS Gate Keeper control the railway gate at the junction	Explore AS, differ...
	2. JOBS-TO-BE-DONE / PROBLEM Prevention of accidents inside the gate Automatically control the railway gate at junction	9. PROBLEM ROOT CAUSE To provide safely for the road users by reducing the accidents as there is no scope of human error in this	7.BEHAVIOUR Sensing,closing of the gate,opening of the gate operation done by software code written on the controller	

3. TRIGGERS Promotion,Adervertisement	10. YOUR SOLUTION Gate keepers not necessary and automatic operations of the gate through the motor. This way it would decreases the cost of gate keeper at the junction and also the gate will closes/open automatically	8. CHANNELS of BEHAVIOUR The reduction of time for which the gate is being kept closed.

4. EMOTIONS: BEFORE / AFTER Before this solution the accident level at gate has maximum death After the solution prevention of accident increases in the gate and also reducing the death.		

4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	256MB RAM	Select the entry in board menu
FR-2	LED	Rated input power of LED luminary efficiency
FR-3	GPS	Data received from multiple GPS satellite
FR-4	Infrared source	Radiation sensitive opto electronic

4.2 NON FUNCTIONAL REQUIREMENT

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Evaluation of the railway self service terminal interface
NFR-2	Security	"Armed force of the union" Protection Force Act,1957
NFR-3	Reliability	Vromans (2005) defines reliability as the percentage of trains arriving within a certain margin from the scheduled
NFR-4	Performance	Indian Railways constantly strive to provide better facilities to its vast set of customers
NFR-5	Availability	Current Availability is the availability and booking of tickets only
NFR-6	Scalability	Algorithm for scheduling bidirectional railway lines (both single- and multi-track)

5.PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.
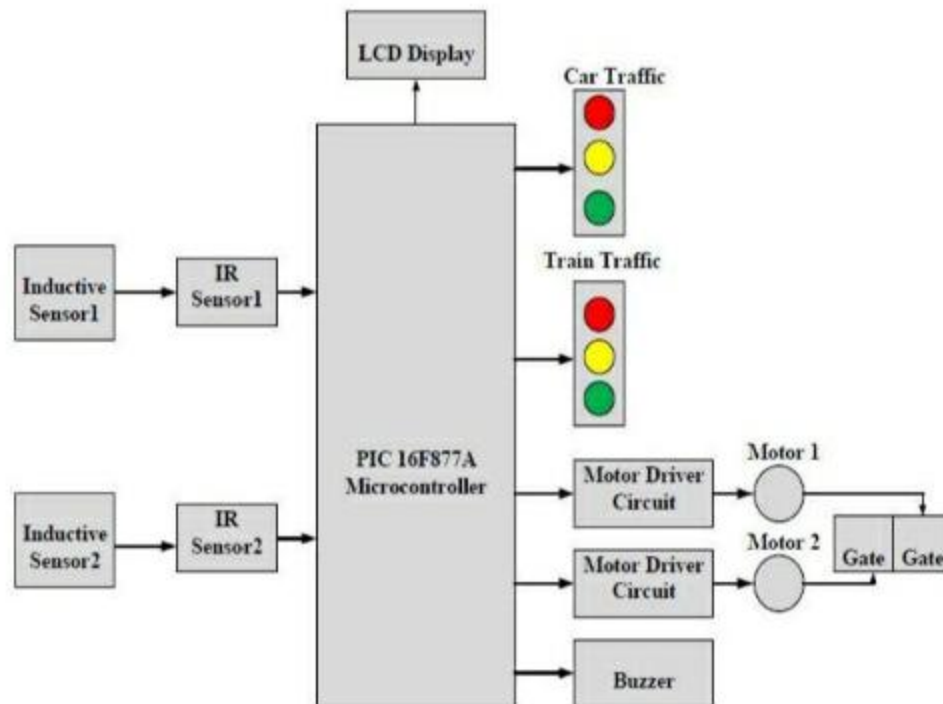
5.2 SOLUTION AND TECHNICAL ARCHITECTURE

Example-Solution Architecture Diagram
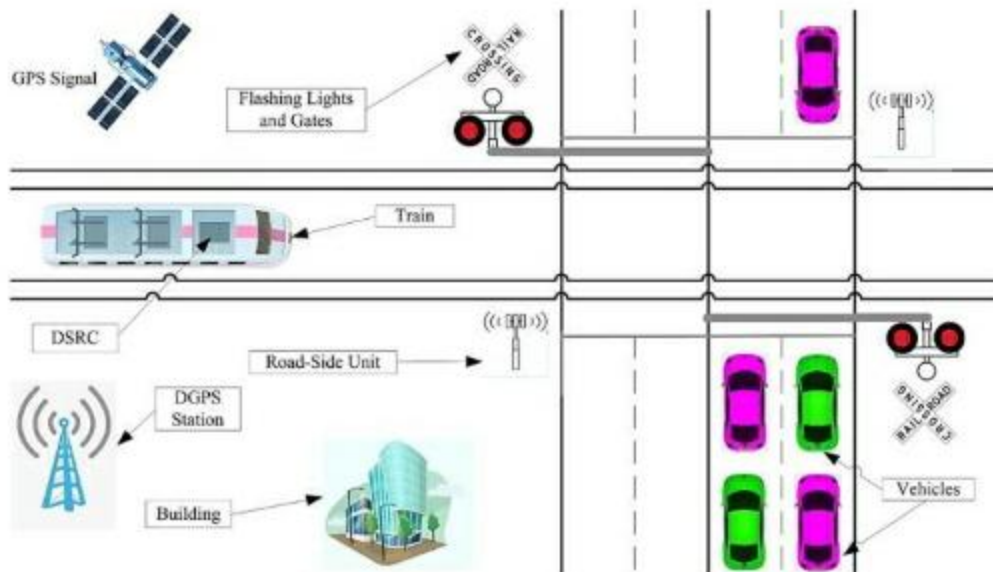
5.3 USER STORIES

Uses Stories

Use the below template to list all user stories for the product

User Type	Functional requirement(Epic)	User Story number	User story/Task	Acceptance Criteria	Priority	R
Arduino	System required to have 256MB RAM on top of operating system.	USN1	ESTx,STM32& other microcontrollers	Select the entry in the tools.Board menu that corresponding to arduino UNO Wifi	High	S
LED	LED based luminare is required for providing illumination	USN2	Free RTOS for blink LED in arduino UNO.	Rated input power ,rated luminous flex Led luminary efficiency	Medium	S
LCD	Operating temperature & storage temperature	USN3	16x2 LCD pin out can help to display characters interfacing.	Contrast ,operating system,operating Temperature & resolution	High	S
GPS	Smart ,flexible,easy to use indoor navigation system	USN4	Location based task remainder system is developed.	Funding & budjet space time based on data received from multiple GPS Satellites	High	S
IR sensor	Infrared source ,transmission medium,optical component	USN5	Measure the heat of an object as well as detect the motion	Have an temperature greater than absolute zero kelvin,radiation sensitive opto electronic.	High	S
GSM	Necessary Base station and trunking equipment	USN6	Make,receive ,sender,delete voice calls,read and search contact	Sensitivity combined with quick respond time digital cellular telecommunications system.	Medium	S

6.PROJECT PLANNING AND SCHEDULING

6.1SPRINT PLANNING AND ESTIMATION

```
Import wiotp.sdk.device
Import time
 Import random
 myConfig = {
"identity": {
 "orgId": "gagtey",
 "typeId": "GPS",
"deviceId":"12345"
 },
 "auth": {
 "token": "12345678"
}
 }
 Def myCommandCallback (cmd):
Print ("Message received from IBM IoT Platform: %s" % cmd.data[„command"])
M=cmd.data[„command"]
 Client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
 Client.connect()
 Def pub (data):
 Client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None)
 Print ("Published data Successfully: %s", myData)
 While True:
myData={„name": „Train1", „lat": 17.6387448, „lon": 78.4754336} pub (myData) time.sleep (3)
#myData={„name": „Train2", „lat": 17.6387448, „lon": 78.4754336) #pub (myData) #time.sleep
(3) myData={„name": „Train1", „lat": 17.6341908, „lon": 78.4744722} pub(myData) time.sleep(3)
myData={„name": „Train1", „lat": 17.6340889, „lon": 78.4745052} pub (myData) time.sleep (3)
myData={„name": „Train1", „lat": 17.6248626, „lon": 78.4720259} pub (myData) time.sleep (3)
myData={„name": „Train1", „lat": 17.6188577, „lon": 78.4698726} pub (myData) time.sleep (3)
myData={„name": „Train1", „lat": 17.6132382, „lon": 78.4707318} pub (myData) time.sleep (3)
client.commandCallback = myCommandCallback clie
myData={„name": „Train1", „lat": 17.6387448, „lon": 78.4754336} pub (myData) time.sleep (3)
Import random myConfig = {
"identity": {
"orgId": "gagtey",
 "typeId": "GPS", "deviceId":"12345"
},
"auth": {
 "token": "12345678"
```

```python
    }
}
Def myCommandCallback (cmd):
 Print ("Message received from IBM IoT Platform: %s" % cmd.data[„command"])
M=cmd.data[„command"]
 Client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
 Client.connect()
 Def pub (data):
 Client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None)
Print ("Published data Successfully: %s", myData
 While True:
 myData={„name": „Train1", „lat": 17.6387448, „lon": 78.4754336} pub (myData) time.sleep (3)
#myData={„name": „Train2", „lat": 17.6387448, „lon": 78.4754336) #pub (myData) #time.sleep
(3)
 myData={„name": „Train1", „lat": 17.6341908, „lon": 78.4744722} pub(myData) time.sleep(3)
myData={„name": „Train1", „lat": 17.6340889, „lon": 78.4745052} pub (myData) time.sleep (3)
myData={„name": „Train1", „lat": 17.6248626, „lon": 78.4720259} pub (myData) time.sleep (3)
myData={„name": „Train1", „lat": 17.6188577, „lon": 78.4698726} pub (myData) time.sleep (3)
myData={„name": „Train1", „lat": 17.6132382, „lon": 78.4707318} pub (myData) time.sleep (3)
client.commandCallback = myCommandCallback client.disconnect (
```

Structural view track crack detection using IoT based system

AUTOMATIC RAILWAY TRACK CRACK DETECTING VEHICLE

S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME
01	SENSOR	04	GEAR ARRANGEMENT	▶	TO CONTROL UNIT
02	CRACK	05	WHEEL		
03	DC MOTOR	06	RAILWAY TRACK		
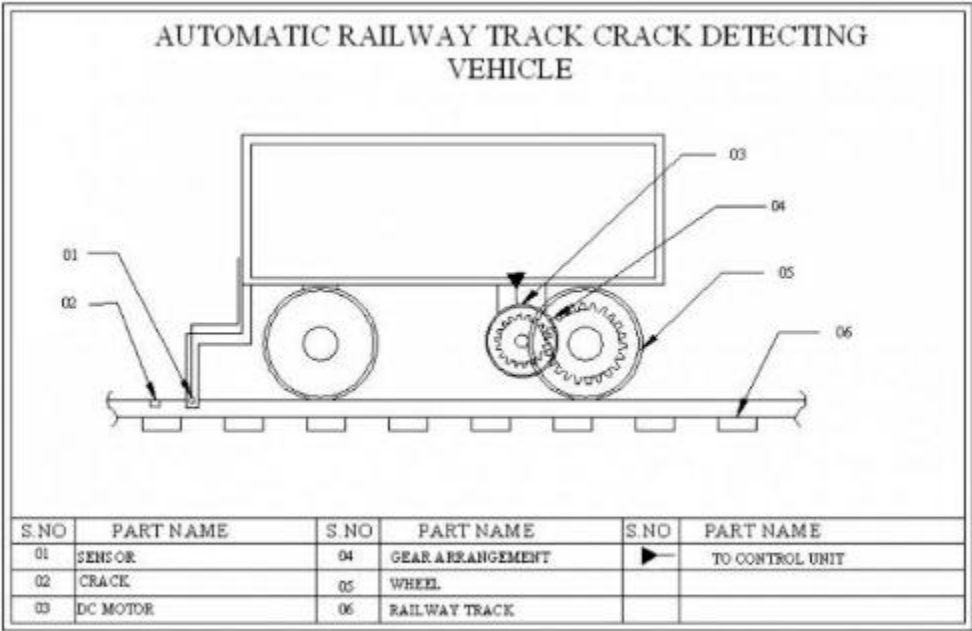
6.2 SPRINT DELIVERY SCHEDULE

1. Identify the problem.

2. Draft the problem statement and abstract.

3. List the requirement.

4. Write the appropriate code.

5. Run in the suitable platform.

6. Test the created code and check the designed prototype.

7. The solution is established

CODING AND SOLUTIONS

7.1 FEATURE -1

- Cloud DB will store the booking details of the passengers..
- Login details of the user will be stored in Mysql using php. • GPS live location tracking feature is added to our project..

7.2 FEATURE- 2

- Node-RED is a programming tool for wiring together hardware devices, APIs and online services in new and interesting ways.
- Node-RED provides a browser-based flow editor that makes it easy to wire together flows using the wide range of nodes in the palette. Flows can be then deployed to the runtime in a single-click JavaScript functions can be created within the editor using a rich text edit.
- A built-in library allows you to save useful functions, templates or flows for re-use.

8.1 TEST CASES

1.Register an account for an new user 2.Login in with the respective credentials	localhost/Try/login	User should navigate to user account homepage	Pass	Megavarshini S
1.Web UI configuration 2.Function Configuration 3. Application flow	http://smart-railways.eu-gb.mybluemix.net/ui/..	Process the information which given by the user and store it in database	Pass	Gokul Erusappan N
1. Enter the appropriate information in required fields. 2. Select the available seat 3. Submit	http://smart-railways.eu-gb.mybluemix.net/ui//	The QR Code should be generated which integrated passenger details	Pass	Shudarvizhi K L
1. Click submit once you enter all the required fields. 2. Go to Cloudant dashboard 3. Click the recent updated metadata	https://95a9ab19-b04c-498f-82e9-fd70bc26bd54-bluemix.cloudant.com/dashboard.html#database/passengerdetails/_all_docs	Passenger details should store in database document	Pass	Dhinakaran U

8.2 USER ACCEPTANCE TESTING

1.Purpose of Document ;
The purpose of this document is to briefly explain the test coverage and open issues of the Ticket boNode-Red, QQR code, GPS location of project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis ;
This report shows the number of resolved or closed buggs at each severity level, and how they were resolved

DEVELOP A WEB APPLICATION USING NODE-RED SERVICE

NODE RED DESIGN

MIT APP

CRACK DETECTOR APP

App installed.

DONE   OPEN

CRACK DETECTOR

9.PERFORMANCE MERTICS

9.PERFORMANCE METRICS

| JOURNEY STEPS Which step of the experience are you describing?	DETECTION OF CRACK Where is the crack occurs in the railway track?	DISCOVERY Why do they even start the journey?	REORGANIZATION Chief Track Engineers then resolve the problem .	EXPLORE THE IDEA Passengers should explore about this technology to find out new technologies related to it.
ACTIONS What does the sensor do?What information do they look for?What is their context?				
NEEDS AND PAINS What does the passengers want to reach(destination) or avoid(accidents).				
TOUCHPOINT What part of the service do they interact with?				

PASSENGER FEELINGS What is the passenger feeling?				

Oppurtunities What could we improve or introduce?	User friendly	Proper Analysis	Features	Monitoring
Process ownership Who is the lead on this?	creator	creator	Product Providers	Passengers and Railway Deapartment

10.ADVANTAGES

• Provides real-time monitoring of and detection of any crack or objects on railway tracks and incase of detection sends information with the location to the receiver side using GPS module via GSM

• Nowadays in the current railway systems, it is becoming necessary to have safety elements in order to avoid accidents.

DISADVANTAGE ;

• Here sensors are used, which will detect the crack accurately.

 • The existing system is slow, tedious and time consuming. This system has GSM and GPS module which will give the real time location or coordinates in the form of Short Message Service (SMS) to the nearest railway station.

11. CONCLUSION

• Ultrasonic sensor is used to detect the crack on the railway track by not receiving the echo from the track; if the echo sound is received then no crack is detected on the track.

 • The output of ultrasonic sensors is given to the microcontroller, which is connected to the GPS, motor driver IC.

12.FUTURE SCOPE

It detects the crack in the railway track in most metropolitan cities and also give an alert to the railway track supervisors.

it may lead to the successfull enhancement modern and safety travelling in train for the passengers.

passengers are aware of railway track crack while publishing the project in the magazines and Indian railway may lead to success.

13.APPENDIX CODE

```
#include<Liquid crystal.h>
 long duration;
int distance;
 const int echoPin =7;
const int trigPin= 6;
 long duration2;
int distance2;
const int echoPin2 =8;
 const int trigPin2= 9;
```

```arduino
int previous= 0;
int previous2= 0;
LiquidCrystal lcd(12,11,5,4,3,2);
void setup(){
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
pinMode(trigPin2, OUTPUT);
pinMode(echoPin2, INPUT);
lcd.begin(16,2); lcd.setCursor(0,0);
lcd.print("Automatic Fault");
lcd.setCursor(0,1);
lcd.print("Detection");
delay(2000);
lcd.clear();
}
void loop(){
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin2, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin2, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
digitalWrite(trigPin2, LOW);
duration2 = pulseIn(echoPin2, HIGH);
distance = duration * 0.034 / 2;
distance2 = duration2 * 0.034 / 2;
if (previous!=distance ||
previous2!=distance2){
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Detecting Fault");
delay(2000);
lcd.clear();
if (distance<50 || distance>55){
lcd.setCursor(0,0);
lcd.print("Fault Detected");
lcd.setCursor(0,1);
```
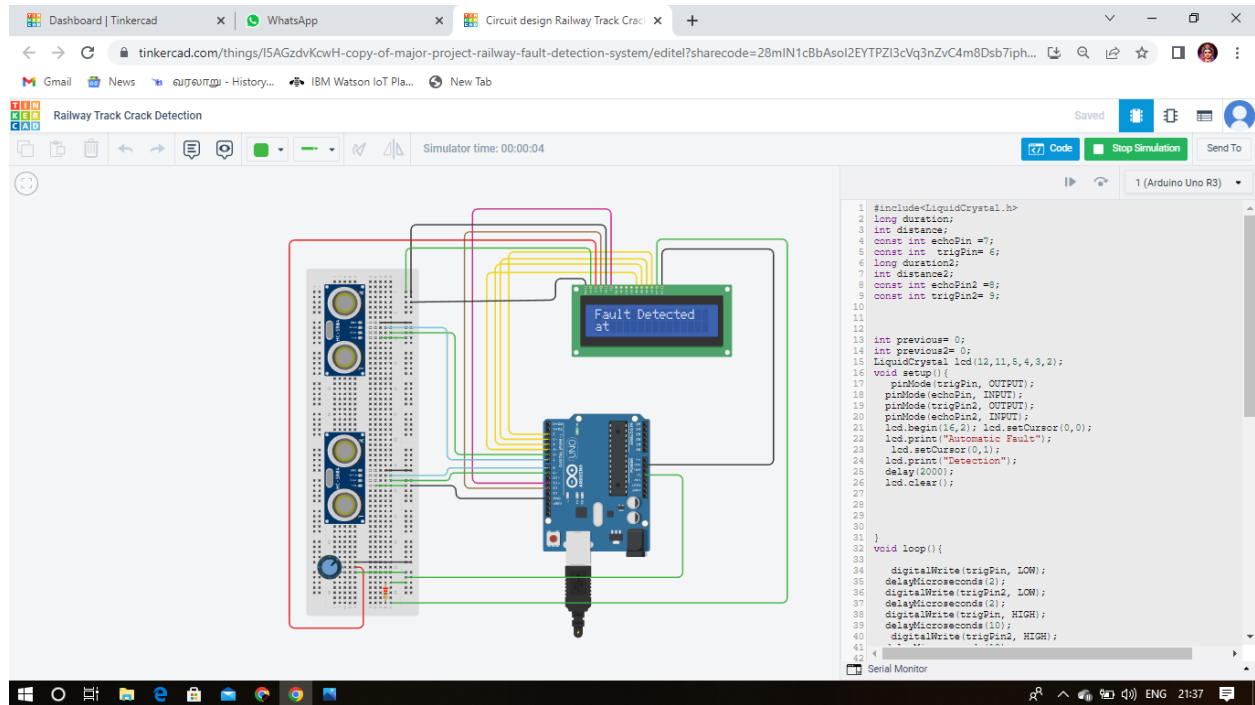
```
lcd.print("at right lane :");
//lcd.print(distance);
delay(2000);
 }
if (distance2<50 || distance2>55){
 lcd.setCursor(0,0);
 lcd.print("Fault Detected");
 lcd.setCursor(0,1);
 lcd.print("at left lane :");
 //lcd.print(distance2);
 delay(2000);
 }
 if ((distance>50 && distance<56)&&
 (distaance2>50 && distance2<56)){
lcd.setCursor(0,0);
 lcd.print("Feel Free & Safe");
 lcd.setCursor(0,1);
 lcd.print("No Fault Detected :");
 //lcd.print(distance2);
delay(2000);
}
previous=distance;
 previous2=distance2;
}
}
```

CIRCUIT DIAGRAM

GITHUB LINK:
https://github.com/IBM-EPBL/IBM-Project-46109-1660738266

DEMO LINK:
https://youtube.com/watch?v=AnmjQfgi4iQ&feature=share

TINKERCAD LINK;
https://www.tinkercad.com/things/I5AGzdvKcwH-copy-of-major-project-railway-fault-detection-system/editel?sharecode=28mIN1cBbAsoI2EYTPZI3cVq3nZvC4m8Dsb7iphTBos