**SMART SOLUTION FOR RAILWAYS**

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**ABSTRACT**

The explosively growing demand of Internet of Things (IoT) has rendered broadscale advancements in the fields across sensors, radio access, network, and hardware/software platforms for mass market applications. In spite of the recent advancements, limited coverage and battery for persistent connections of IoT devices still remains a critical impediment to practical service applications. In this paper, we introduces a cost-effective IoT solution consisting of device platform, gateway, IoT network, and platform server for smart railway infrastructure. Then, we evaluate and demonstrate the applicability through an in-depth case study related to IoT-based maintenance by implementing a proof of concept and performing experimental works. The IoT solution applied for the smart railway application makes it easy to grasp the condition information distributed over a wide railway area. To deduce the potential and feasibility, we propose the network architecture of IoT solution and evaluate the performance of the candidate radio access technologies for delivering IoT data in the aspects of power consumption and coverage by performing an intensive field test with system level implementations. Based on the observation of use cases in interdisciplinary approaches, we figure out the benefits that the IoT can bring.

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**INTRODUCTION**

We wanted to be apart of our surrounding with some change and advancement so that it can bring the better life of the middle class and lower class people to travel in high security and advanced locomotion. he train is one and only most widely used transportation, and not only for this they are used for goods transportation also. Indian railways are not able to facilitate the customer properly due to crowded amount of people. Statistics show that the leading cause of death by injury in railways traffic accidents (two train collision each other). There are number of causes for which an accident can occur, some of them are; lack of training for driving or less experienced, use of mobile phone while driving, unskilled drivers, driving while intoxicated, bad railway tack condition, overloading in train and negligence traffic management. Naturally,  
continuous operation with stringent quality requirements turns inspection and  
maintenance into critical activities, for which procedures, tools, and technologies must be developed and put in place. Moreover, constant monitorization of both vehicles and infrastructure is crucial. Thus railway monitoring and maintenance activities are unavoidable. On the other hand, these must be done in a cost-effective way, taking advantage of all technological advances for  
simultaneously delivering the needed functionality and reducing cost. In this survey paper, we briefly review selected railway accidents detection techniques and propose a solution. Rear end crashes occur mainly due to obstacle and crack in tracks. According to recent statistics, a major percentage of train accident happen due to not proper surveillance of railway track.

* 1. **PROJECT OVERVIEW:**

SMART SOLUTIONS FOR RAILWAYS can be performed using one of several approaches, each of them having different consequences in terms of reliability, safety, downtime, human resources, and cost. Overview of the state-of-the-art on train and infrastructure anomaly detection, together with an analysis on how the existing approaches address the identified requirements. The certain requirement approaches comprising;(1)sensors, and the differences between them, (2) communication systems, with focus on 5G, and (3) data processing, more specifically, offline and online processing and also its explains the requirements of railway solution systems; (1) Approaches to Smart Railway Maintenance , (2) Supporting Technologies , and (3) Requirements. Due to its large size it is difficult to monitor the cracks in tracks manually. This paper deals with this problem and detects cracks in tracks with the help of ultrasonic sensor attached to moving assembly with help of stepper motor. Ultrasonic sensor allows the device to moves back and forth across the track and if there is any fault, it gives information to the cloud server through which railway department is informed on time about cracks and many lives can be saved. This is the application of IoT, due to this it is cost effective system. This effective methodology of continuous observation and assessment of rail tracks might facilitate to stop accidents. This methodology endlessly monitors the rail stress, evaluate the results and provide the rail break alerts such as potential buckling conditions, bending of rails and wheel impact load detection to the concerned authorities.

* 1. **PURPOSE:**

Internet is basically system of interconnected computers through

network. But now its use is changing with changing world and it is not just

confined to emails or web browsing. Today’s internet also deals with embedded sensors and has led to development of smart homes, smart rural area, e-health care’s etc. and this introduced the concept of IoT . Internet of Things refers to interconnection or communication between two or more devices without human-to-human and human-to-computer interaction. Connected devices are equipped with sensors or actuators perceive their surroundings. IOT has four major components which include sensing the device, accessing the device, processing the information of the device, and provides application and services. In addition to this it also provides security and privacy of data . Automation has affected every aspect of our daily lives. More improvements are being introduced in almost all fields to reduce human effort and save time. Thinking of the same is trying to introduce automation in the field of track testing. Railroad track is an integral part of any company's asset base, since it provides them with the necessary business functionality. Problems that occur due to problems in railroads need to be overcome. The latest method used by the Indian railroad is the tracking of the train

track which requires a lot of manpower and is time-consuming.

**2.LITERATURE SURVEY**

**2.1EXISTING SYSTEM**

1.**Journal Name:** “Development of a machine visionsystemforinspection of railroad track”.

**Author Name**: S.Sawadisavi , J.Edwards, E.Resend, J.Hart, C.Barkan,and N.Ahuja.

In European cities, the majority of the public transit infrastructureiseasily accessible. The majority of the train stations are positionedinanopenand "gate-free" environment, easy available to everyone andhencepresents possible problems in the system. Due of this, fare dodgingboardinga tram or train without purchasing a ticket is simple. This studyproposesaconceptual framework and architecture to detect and track passengersusingan RFID distance scan in conjunction with people counting methods, withthegoal of capturing free riders in an early stage. It is a ticketing systembasedonRFID that utilises a OV-Chip card is a smartcard. The findings demonstratethat using an alternative system architecture increase in gettingfreetrips inspectors are at a far early stage.

2**.JOURNAL NAME:**“Solid-state interlocking(SSI): anintegratedelectronic signaling system for mainline railways”, IEE proceedings, 2012.

**AUTHOR NAME:**A..H Cribbens

In the fast developing country, people are facing many accidents; itwould be indesirable for any nation to losing their life for unwantedcause.Railways are one of the important transports in India. There is aneedformanual checking to detect the crack on railway track and always railwaypersonnel takes care of this issue, even though the inspectionismaderegularly. Sometimes the crack may unnoticed . Because of this thetrainaccident or derailment may occur. In order to avoid this situation and automate therailway crack detection has been proposed. Here ultrasonicsensor is used to detect the crack in the railway track by measuringdistancefrom track to sensor, if the distance is greater than the assignedvaluethemicrocontroller identifies there is a crack, also it tells the exact locationofthecrack by the formula “DISTANCE=SPEED\*TIME”. While the checkingprocess is going on, the train may approach, it is identified by thevibrationsensor and gives alert to the microcontroller, there by shrinks the sizeoftherobot between the two tracks. After the train has crossed it returnstoitsnormal position and continue its checking process

3.**JOURNAL NAME:**  Autonomous railtrack inspectionusing visionbasedsystem,” in Proc. IEEE Int. Conf. Comput. Intell. Homeland Secur. Pers.Safety, 2009

**AUTHOR NAME :** smita.s.bhavasar.

RFID method to prevent aircraft collision the railway transportationnetwork is thought to be the safest and simplest network, however it isnolonger that much safer since numerous crashes and accidents happenduetopoor network communication, incorrect signalling, bad weather, andsuddenchanges in track or route. Due to the speed of moving trains, whichnecessitates a lead space for stopping, it is exceedingly challengingtopreventsuch collisions. Around the world, there have been several trainaccidents.According to a CNN IBN India story dated September 2011 Humanmistakeaccounts for 85% of train accidents, either the driver or the main control roombefore a collision. There is currently no way to prevent train collisions. ACD(anti-collision device) system-based solutions have been put intoplacebyIndian Railways. Due to their design concept of using GPSfor trackrecognition and having a high implementation cost, they have inherent issuesin the Station portion and close to mountains. My system, whichreliesonRFID, ARM Controller, and GSM to assist solve the aforementionedissues,uses automated surveillance to help eliminate train accidents. Eachtrainreadsand transmits its track id to surrounding trains in this system, whichassignsatrack id to each train track. if there are two trains travelling at the sametime.

4.**JOURNAL NAME :** “Ultrasonic characterisation of defects inrails,”Insight, vol.44, no. 6, pp. 341–347, 2002.

**Author name :** R. Clark, S. Singh, and C. Haist.

In India, as most of the commercial transport is carried out throughtherail network, problems with this network can be highly damagingtotheeconomy, regardless of the social consequences of loss of life or limb. I have.This white paper proposes an inexpensive yet robust solution totherailwaybreakage detection problem. The method is simple in idea, but completelynew and unique in the sense that it has not been tested to date. Thispaperdescribes the technical and design aspects in detail and alsoprovidesaproposed robust crack detection algorithm. The paper also presents detailsofhis RRCDS implementation results using simple components suchasaGPSmodule, a GSM modem and an LED-LDR based crack detector assembly.The proposed scheme is modeled for robust implementation intheIndianscenario.

1. **JOURNAL NAME:** “Integrating automatic verificationof safetyrequirements in railway interlocking system design”, The 6thIEEEInternational Symposium on High Assurance Systems Engineering(HASE’01), Washington, USA 2011.

**Author name : poovizhi .s**

The sensors are made up of a transistor, an Op-amp, a handful ofresistors, and a few IR leds. A wireless sensor network (WSN) is a networkofautonomous sensors-equipped devices that is spatially distributedandwireless. This WSN technology offers distributed nodes andwirelesscommunication to the wired world. The 900 MHz frequency usedbythewireless protocol is chosen based on the needs of the application. Theprotocol uses 2.4 GHz radios that are compliant with IEEE 802.15.4or IEEE802.11 (Wi-Fi) standards. The issues that train passengers encounterarenumerous. One of them is the absence of water in the train, travellerstakinglong distance trains must either travel with a meagre supply of waterorwithout any at all. The availability of seats in trains is another issue. Topurchase tickets for the train they want to take, passengers must wait inlinefor a very long time. It will be quite difficult for a passenger to gobytrainifthere is nowhere for them to sit. For operation, the IRmodule uses358comparator ICs. When it detects an IR frequency, the sensor's output changesto logic 1, otherwise to logic 0. Leds can be used to examine the sensor'sstate,and no further hardware is needed.This means there are no openseatsforincoming guests. The availability of seats for new customers is indicatedifthe IR led did not detect any reflected signal. Normally, the output pinis low.The receiver LED will be off even though the IR LEDis continuouslytransmitting since there is nothing to reflect back to the IRreceiver owingtoan obstruction. The IR receiver's output decreases when an obstructionisencountered. The obstacle surface reflects the IR signal. Thecomparator's output will be driven low as a result. The LED's cathode is then linkedtothisoutput, which causes it to illuminate.

**2.2 REFERENCE :**

1.S.Sawadisavi J.Edwards, E.Resend, J.Hart, C.Barkan, andN.Ahuja ,“Development of a machine vision systemfor inspectionofrailroad track,” in Proc. Amer. Railway Eng. Maintenance wayAssoc. Annu. 2012.

2.A.H. Cribbens, “Solid-state interlocking(SSI): anintegratedelectronic signaling systemfor mainline railways”, IEE proceedings, 2012.

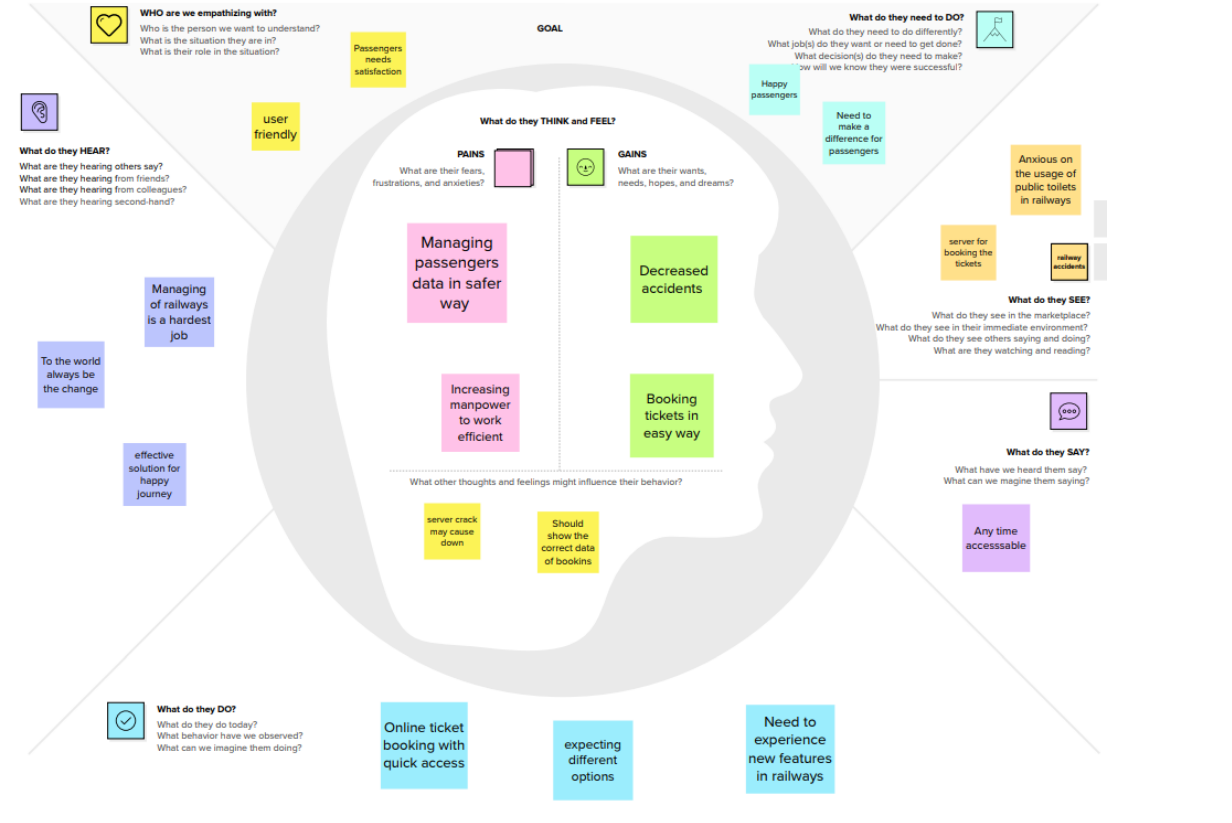
3.Smita S. Bhavsar Department of E&TC Engineering, ZealEducation Society’s Zeal College of Engineering andResearch, Maharashtra, Pune, India.

4.R. Clark, S. Singh, and C. Haist, “Ultrasonic characterisationofdefects in rails,” Insight, vol.44, no. 6, pp. 341–347, 2002.

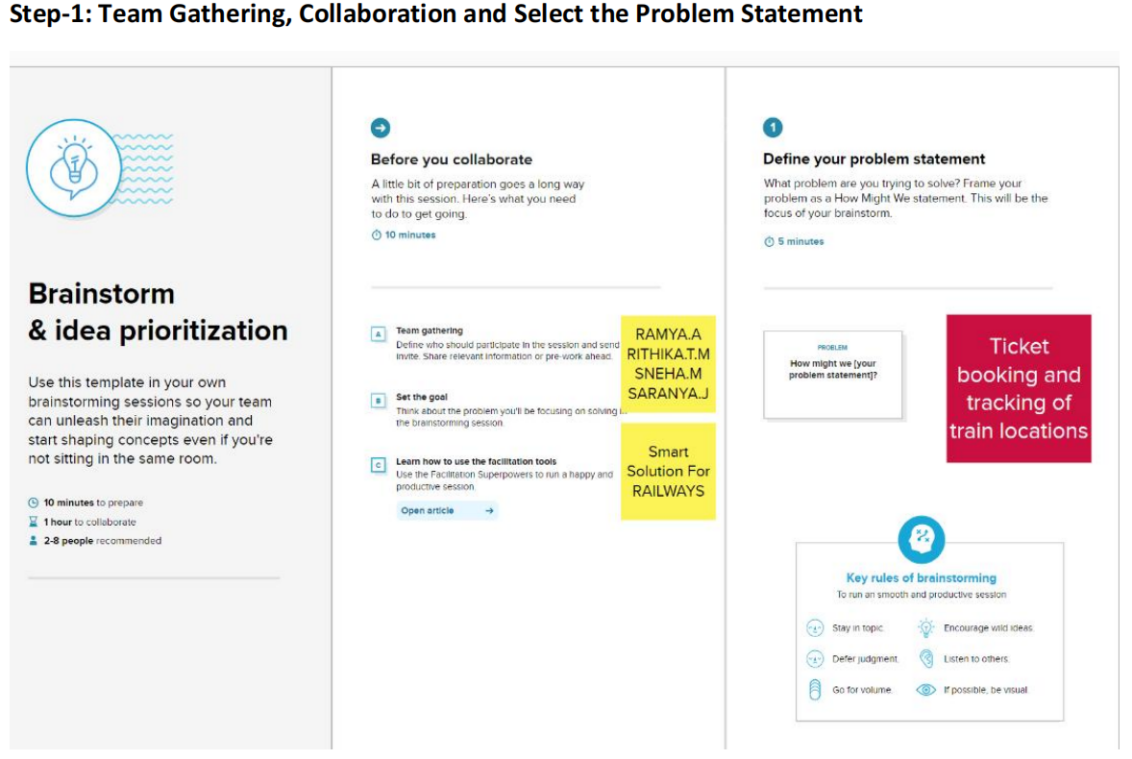
5.POOVIZHI.s Assistant Professor Department of Electronics and Communication Engineering R.M.K.College of EngineeringandTechnology Puduvuyal, Tamilnadu, India.

**3.IDEATION AND PROPOSED SOLUTION**

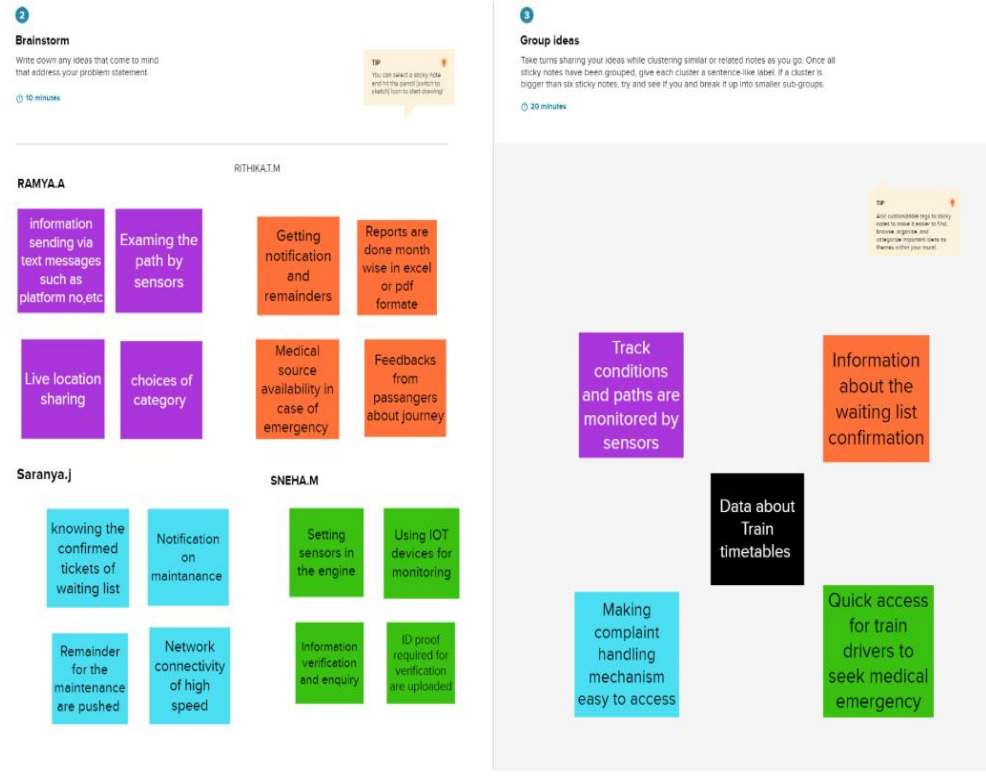
**3.1 Empathy map**

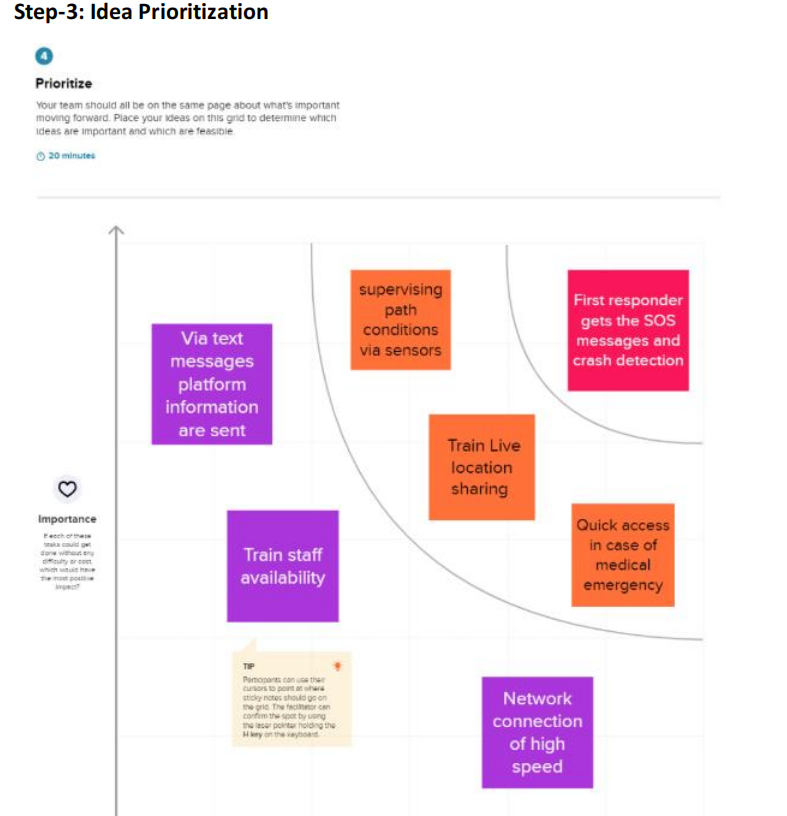


**3.2. IDEATION AND BRAINSTROMING**



**Step-2: Brainstorm, Idea Listing and Grouping**

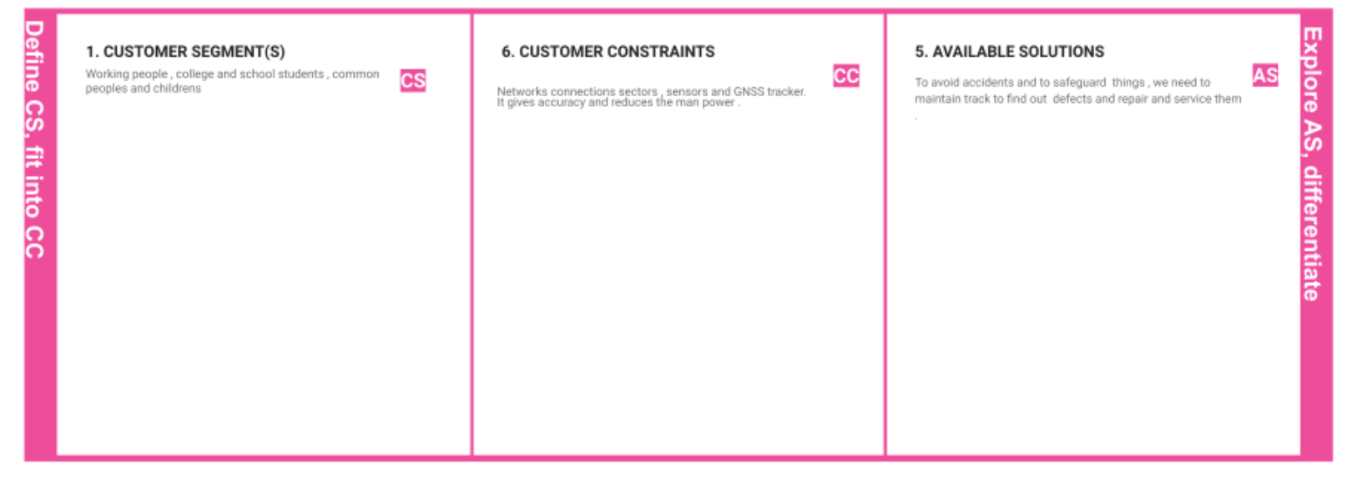


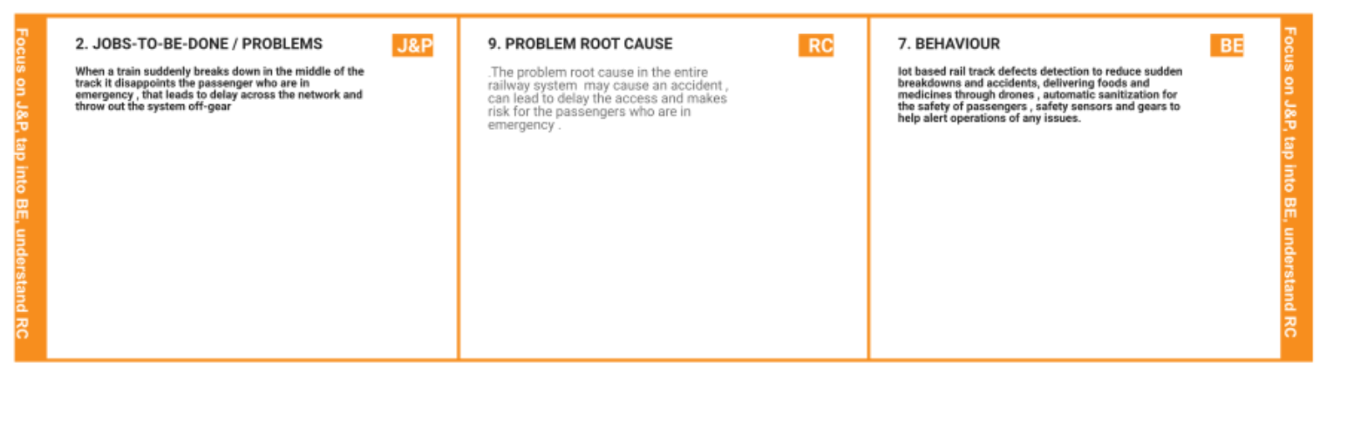


**3.3. PROPOSED SOLUTION**

|  |  |  |
| --- | --- | --- |
| **S.No.** | **Parameter** | **Description** |
|  | Problem Statement (Problem to be solved) | Smart Solution For Railways Using IOT |
|  | Idea / Solution description | Smart Railways includes the passenger ticket generation ,ticket validation and authorization under IoT system.Managing and securing the passengers data is the most important aspect of using smart railways. |
|  | Novelty / Uniqueness | Accuracy of information.  Efficiency of operation is high.  Low maintenance cost. |
|  | Social Impact / Customer Satisfaction | In terms of needs and comforts of passengers using smart railway availability of seats,comfortable in units of carriage,temperature,smoothness of ride,and punctuality are important aspects. |
|  | Business Model (Revenue Model) | Global System Mobile Communications Railway  Long Term Evaluation  Fifth Generation  Wireless Sensor Networks |
|  | Scalability of the Solution | The Smart railways enters passengers details as input that will match with the the UIDAI database and that information is stored in railway reservation database.Experimental results are obtained by using PYTHON programming language.The total time required to book a ticket is not more than 4 mile seconds which provides efficient searching and operation for fast booking. |

**3.4 problem solution fit**







1. **REQUIREMENT ANALYSIS**

**4.1.Functional Requirements:**

Following are the functional requirements of the proposed solution.

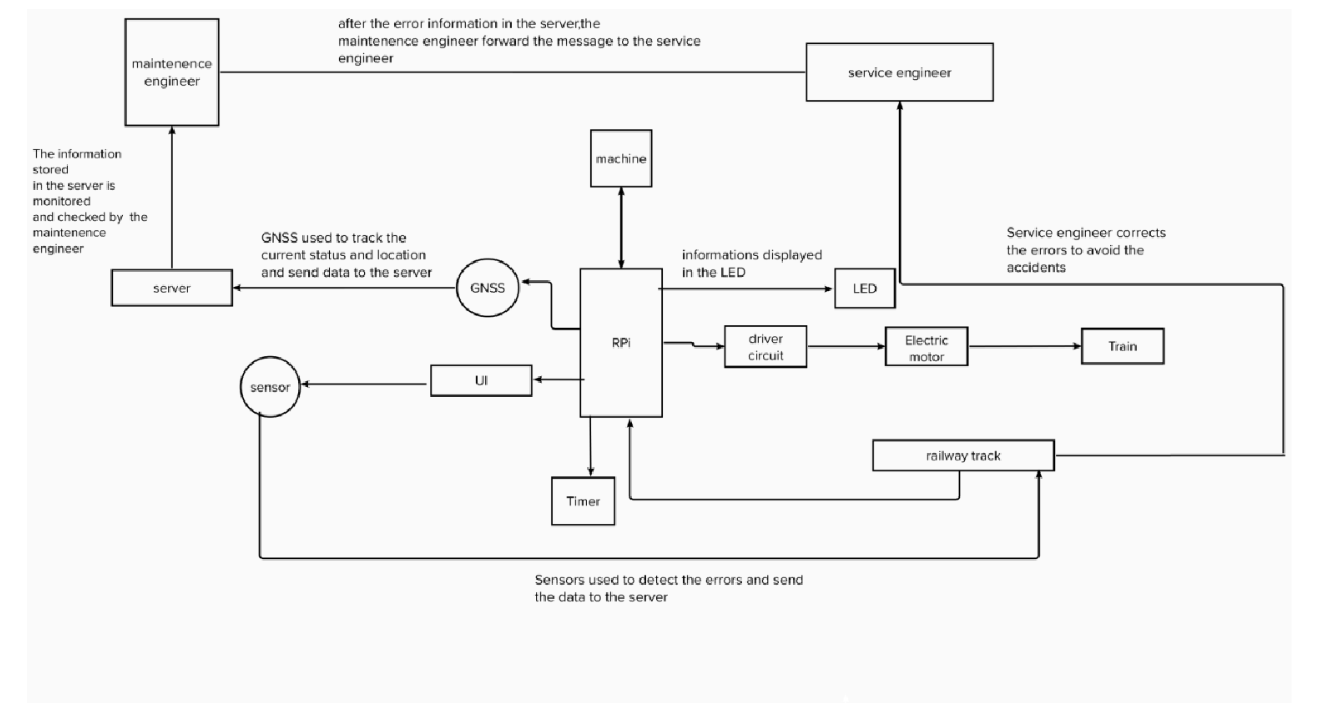
|  |  |  |
| --- | --- | --- |
| **FR No.** | **Functional Requirement (Epic)** | **Sub Requirement (Story / Sub-Task)** |
| FR-1 | pasenger ticket booking | Ticket booking is done by railway app and website through online . |
| FR-2 | Booking confirmation | Booking confirmation via message or Gmail . |
| FR-3 | PassengerPassengers objections and feedback | Through onlinemessage or Gmail to the respectrespective authority . |
| FR-4 | Passenger schedule | Time scheduling is done by mobile application . |
| FR-5 | Passenger emergency | In emergency situation like theft or accident complaints can be filed through online . |
|  |  |  |

**4.2.functional Requirements:**

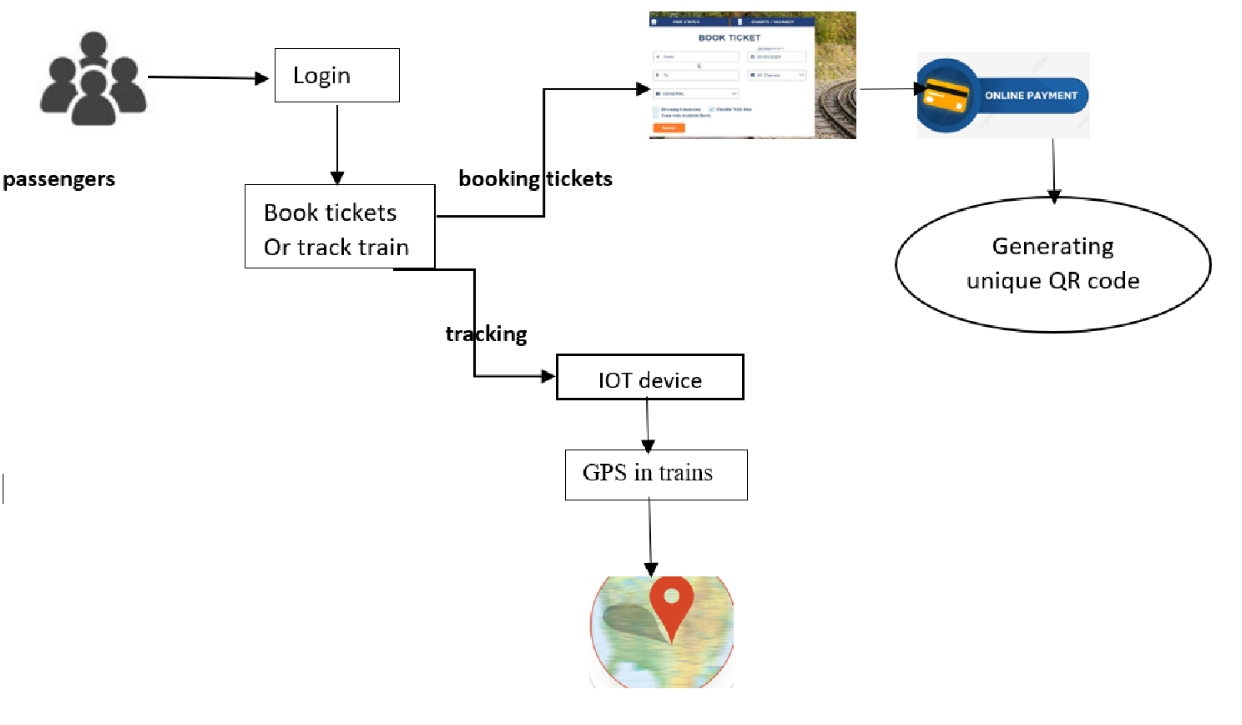
Following are the non-functional requirements of the proposed solution.

|  |  |  |
| --- | --- | --- |
| **FR No.** | **Non-Functional Requirement** | **Description** |
| NFR-1 | **Usability** | We can detect cracks in railway tracks in highly usable remote railwayrailways by periodic maintenance. |
| NFR-2 | **Security** | By using sensors in tracks any damage or accident is detected. |
| NFR-3 | **Reliability** | Traffic lights and signalling is more reliable. |
| NFR-4 | **Performance** | Communication plays a vital role in transferring the crack detected signal to the respective authority. |
| NFR-5 | **Availability** | Availability of safe routes to the train is done by transferring signals of damaged paths. |
| NFR-6 | **Scalability** | Easy to expand and handle . |

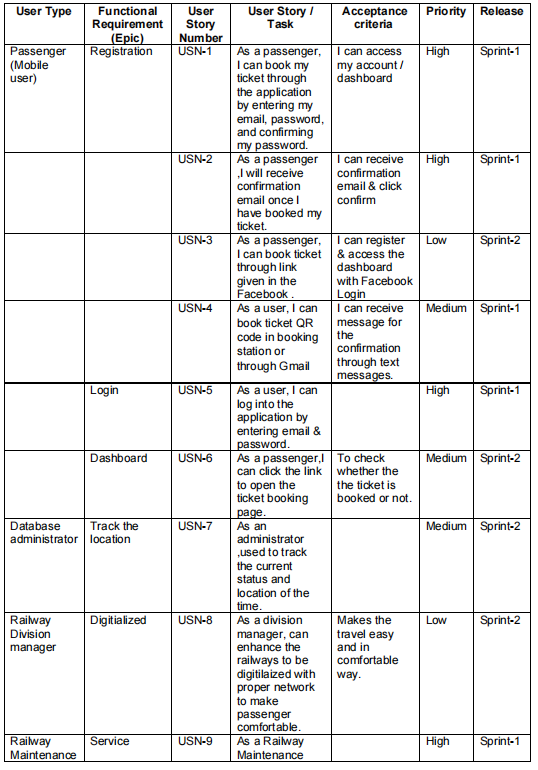
1. **PROJECT DESIGN** 
   1. **DATA FLOW DIAGRAM**

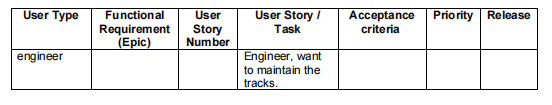


* 1. **SOLUTION ARCHITECTURE**



**5.3.USER STORIES**





1. **PROJECT PLANNING AND SCHEDULING**

**6.1 SPRINT PLANNING**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sprint | Functional Requirements | User Story Number | User story / Track | Priority | Team  members |
| Sprin1 | Registration | USN-1 | As a passenger ,I can register for the application by entering my email , password . and confirming my password | high | RITHIKA.T.M  RAMYA.A |
| Sprin1 |  | USN-2 | As a passenger ,I will receive conformation email or message once I have booked | high | RITHIKA.T.M  RAMYA.A |
| Sprint1 | Login | USN-3 | As a passenger ,I can log into the application by entering email & password | high | RAMYA.A  RITHIKA.T.M |
| Sprint2 | Books ticket | USN-4 | I can select the train and the way to be travelled | medium | SARANYA.J  SNEHA.M |
| Sprint2 |  | USN-5 | I fill the basic data like name,age,phone number,email id,etc | high | SARANYA.J  SNEHA.M |
| Sprint2 | Selecting the seat | USN-6 | After filling the data ,I can select the seat | medium | SARANYA.J  SNEHA.M |
| Sprint2 | QR code Generation | USN-7 | At last qr code is generated that contains the information of the individual passenger | high | SARANYA.J  SNEHA.M |
| Sprint3 | Tracking the location of train | USN-8 | As a passanger ,I Can current location of the train is tracked | medium | SARANYA.J  SNEHA.M |
| Sprint3 | login | USN-9 | As a administrator ,I Can log into the application by entering email & password | medium | SARANYA.J  SNEHA.M |
| Sprint4 | Cancel the booking | USN-10 | As a administer , I Can Cancel the ticket if the information of the passenger is incorrect | low | RAMYA.A,  RITHIKA.T.M |
| Sprint3 | TTR verifies the passenger | USN-11 | As a ticket checker I can scan the passengers qr code | high | SARANYA.J  SNEHA.M |

**6.2. SPRINT DELIVERY SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sprint | duration | Sprint start date | Sprint end date  (planned) | Sprint release date (actual) |
| Sprint 1 | 6 days | 24 October 2022 | 31 October 2022 | 19 November 2022 |
| Sprint2 | 6 days | 1 November 2022 | 6 November 2022 | 19 November 2022 |
| Sprint3 | 6 days | 7 November 2022 | 14 November 2022 | 19 November 2022 |
| Sprint4 | 4 days | 15 November 2022 | 19 November 2022 | 19 November 2022 |

**7.CODING & SOLUTIONING**

**7.1 FEATURE 1**

IBM Watson platform

Node red

Cloudant DB

Ticket cancellation

Adding Queries

**7.2 FEATURES 2**

Registration

Login

Verification

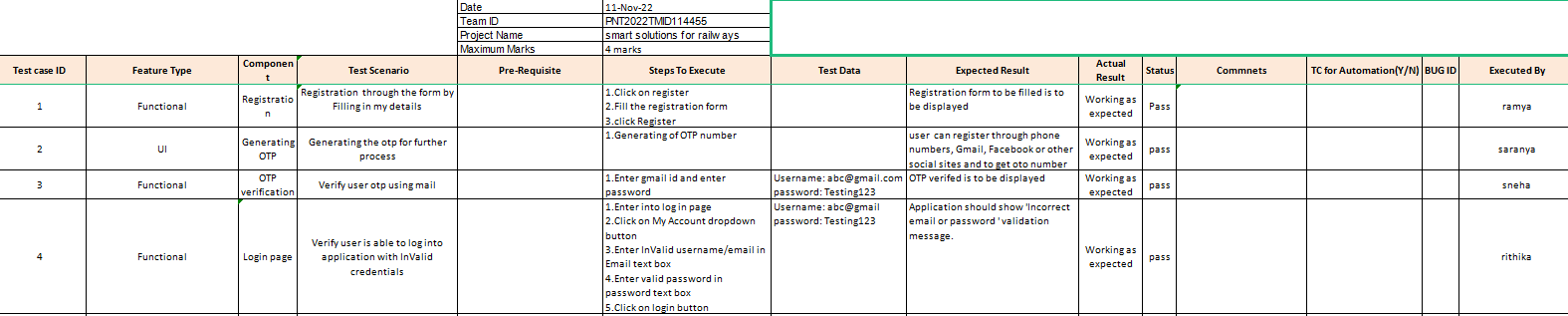
Ticket booking

Payment

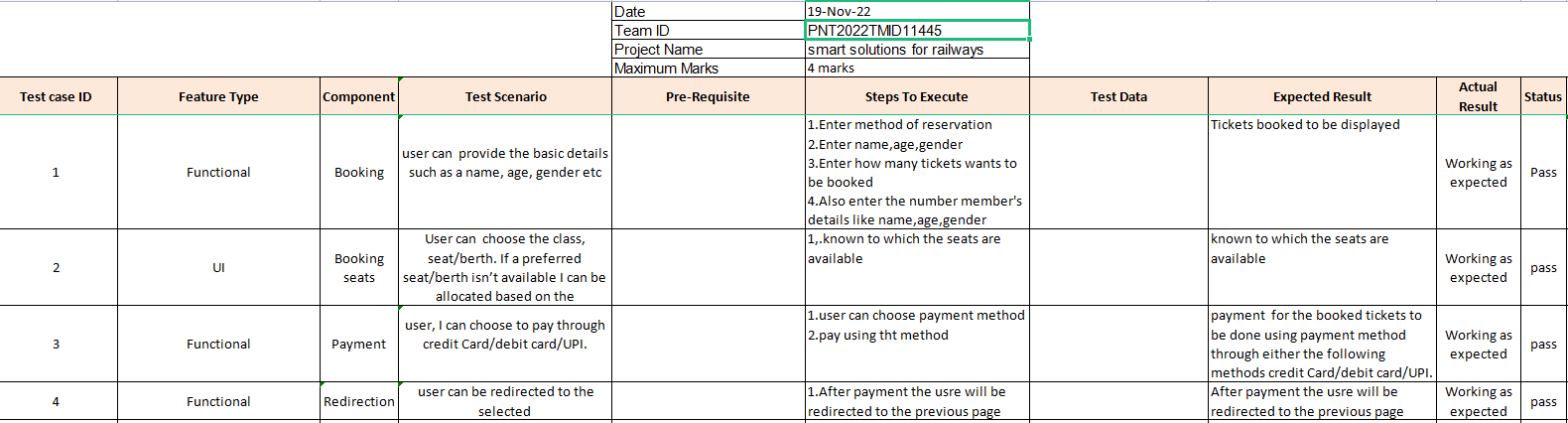
**8 TESTING**

**8.1 TESTCASE**

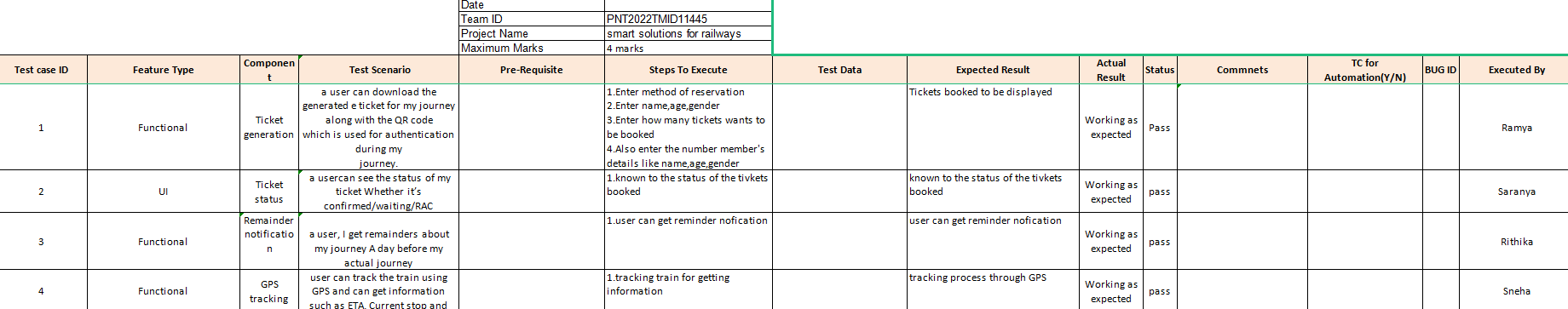
**SPRINT 1**



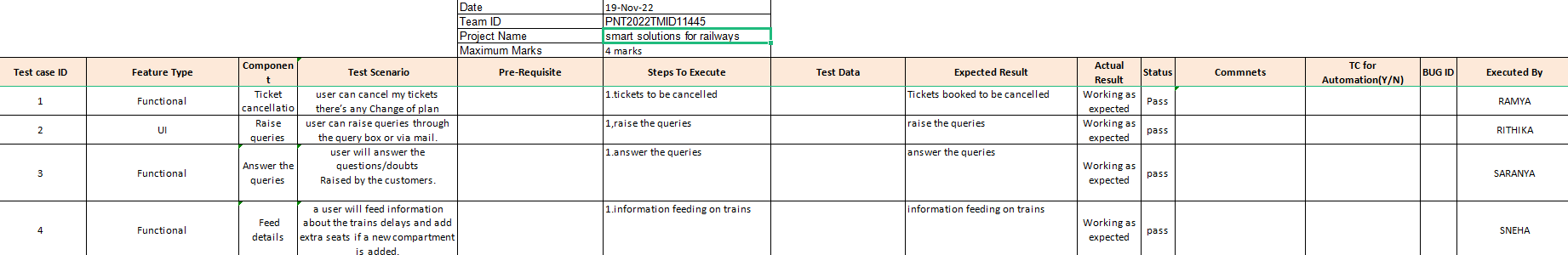
**SPRINT 2**



**SPRINT 3**



**SPRINT 4**



**9.RESULTS**

**9.1. PERFORMANCE METRI**



**10.ADVANTAGES AND DISADVANGES**

**10.1.ADVANTAGES**

* Openness – compatibility between different system modules,

potentially from different vendors;

* Orchestration – ability to manage large numbers of devices, with full

visibility over them;

* Dynamic scaling – ability to scale the system according to the

application needs, through resource virtualization and cloud operation;

* Automation – ability to automate parts of the system monitoring

application, leading to better performance and lower operation costs.

**10.2.DISADVANTAGES**

 Approaches to flexible, effective, efficient, and low-cost data

collection for both railway vehicles and infrastructure monitoring,

using regular trains;

 Data processing, reduction, and analysis in local controllers, and

subsequent sending of that data to the cloud, for further processing;

 Online data processing systems, for real-time monitoring, using

emerging

 communication technologies;

 Integrated, interoperable, and scalable solutions for railway systems

preventive maintenance.

**11.CONCLUSION**

Accidents occurring in Railway transportation system cost a large number of

lives. So this system helps us to prevent accidents and giving information about

faults or cracks in advance to railway authorities. So that they can fix them and

accidents cases becomes less. This project is cost effective. By using more

techniques they can be modified and developed according to their applications. By this system many lives can be saved by avoiding accidents. The idea can be

implemented in large scale in the long run to facilitate better safety standards for rail tracks and provide effective testing infrastructure for achieving better results in the future.

**12.FUTURE SCOPE**

In future CCTV systems with IP based camera can be used for monitoring the visual videos captured from the track. It will also increase security for both passengers and railways. GPS can also be used to detect exact location of track fault area, IP cameras can also be used to show fault with the help of video. Locations on Google maps with the help of sensors can be used to detect in which area track is broken

**13.APPENDIX**

**13.1.SOURCE PROGRAM**

import wiotp.sdk.device

import time

import random

myConfig={

"identity": {

"orgId": "kbzwt4",

"typeId": "NodeMCU",

"deviceId": "12345"

},

"auth": {

"token": "12345678"

}

}

def myCommandCallback(cmd):

print("msg 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':'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)

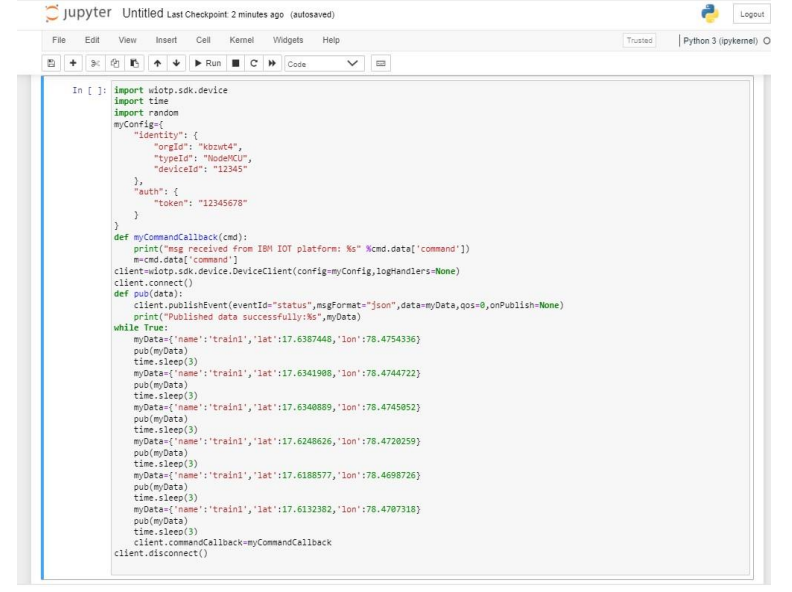
myData={'name':'train1','lat':17.6132382,'lon':78.4707318}

pub(myData)

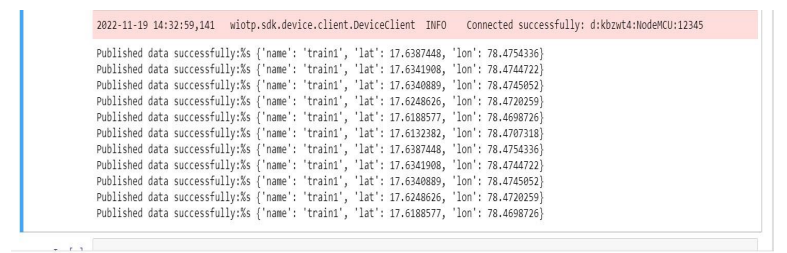
time.sleep(3)

client.commandCallback=myCommandCallback

client.disconnect()



OUTPUT



**QR CODE GENERATION**

from http import client

import cv2

import pyzbar

from pyzbar.pyzbar import decode

import time

from ibmcloudant.cloudant\_v1 import CloudantV1

from ibmcloudant import CouchDbSessionAuthenticator

from ibm\_cloud\_sdk\_core.authenticators import BasicAuthenticator

authenticator = BasicAuthenticator('apikey-v2-rsy830cz1zi58n2c6r65zltdnil5hsvuehtcomsrbbe', '8c8217f7524c8e496de81adc45fd866d')

service = CloudantV1(authenticator=authenticator)

service.set\_service\_url('https://apikey-v2-rsy830cz1zi58n2c6r65zltdnil5hsvuehtcomsrbbe:8c8217f7524c8e496de81adc45fd866d@ba67c7fa-520d-4bdc-9344-0a240f78077b-bluemix.cloudantnosqldb.appdomain.cloud')

cap= cv2.VideoCapture(0)

font = cv2.FONT\_HERSHEY\_PLAIN

while True:

\_, frame = cap.read()

decodedObjects = decode(frame)

for obj in decodedObjects:

#print ("Data", obj.data)

a=obj.data.decode('UTF-8')

cv2.putText(frame, "Ticket", (50, 50), font, 2, (255, 0, 0), 3)

#print (a)

try:

response = service.get\_document(

db='ibm\_railways',

doc\_id = a

).get\_result()

print (response)

time.sleep(5)

except Exception as e:

print(a)

print ("Not a Valid Ticket")

time.sleep(5)

cv2.imshow("Frame",frame)

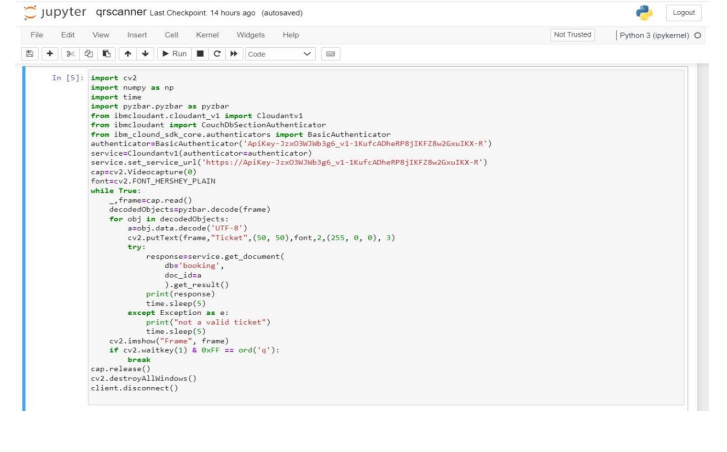
if cv2.waitKey(1) & 0xFF ==ord('q'):

break

cap.release()

cv2.destroyAllWindows()

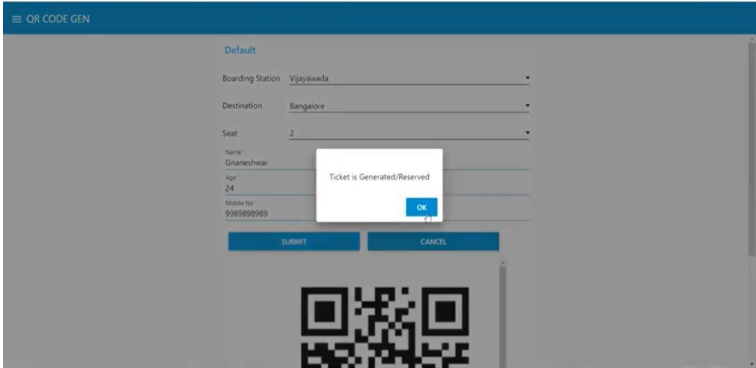
client.disconnect()

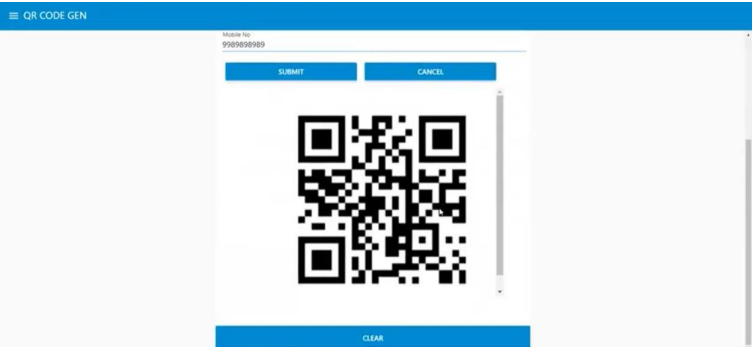


**Output**

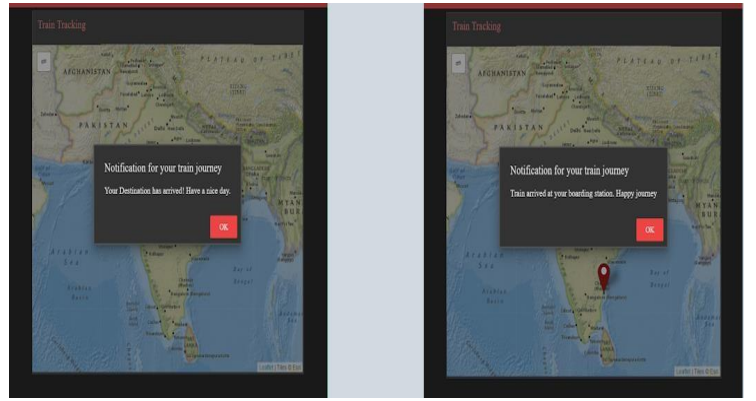












**GITHUB& PROJECT DEMO LINK :**

[**https://github.com/IBM-EPBL/IBM-Project-39201-1660400380**](https://github.com/IBM-EPBL/IBM-Project-39201-1660400380)

**https://drive.google.com/file/d/1nFkAncu8o9U1MiaTn\_sLvnTzqO\_fb2n\_/view?usp=sharing**