

SMART SOLUTIONS FOR RAILWAYS

PROJECT REPORT

TEAM ID : PNT2022TMID35329

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1. INTRODUCTION

1.1 Project Overview

A Web page designed for the public to book tickets based on availability and convenience. The portal generates a QR code on booking and is used for verification while boarding. It basically serves as an E-ticket. A GPS module is used in the train for tracking and updating the live status of the journey continuously through the App. All the booking details of the customers will be stored in the database with a unique ID and retrieved back when the Ticket Collector scans the QR Code.

1.2 Purpose

To improve passenger's travel experience, assure their safety, remove any confusion, mitigate the effects of delays and use latest technology instead of traditional methods of printed tickets and manual verification.

2. LITERATURE SURVEY

2.1 Existing problem

Carrying a physical copy of ticket and manual verification is time consuming and inefficient. The existing system doesn't prevent unreserved and waiting list passengers from travelling without tickets.

2.2 References

Smart Train Detector using IoT Approach

https://www.researchgate.net/publication/334763350_Smart_Train_Detector_using_IoT_Approach

An IoT enabled approach has been adopted to detect the arrival of trains. To detect the arrival of trains, metal detection in the railway tracks is not sufficient as the sensors present in the railway tracks just detect any metal object and cannot distinguish between a train or a mere coin. Thus, in order to make the working more foolproof, introduction of another parameter, i.e., weight on the railway track is necessary. This paper describes an approach to collaborate metal detection with weight detection in railway tracks to detect train movement using the principle of IoT. The key idea here is to use load cells along with metal sensors.

GPS and Ethernet based real time train tracking system

https://www.researchgate.net/publication/261429777_GPS_and_Ethernet_based_real_time_train_tracking_system

In the railway sector, tracking traffic violations and the resulting accidents are a major issue. This issue can be dealt with to some extent if somebody could properly monitor/track the individual trains. Tracking trains manually is a cumbersome process, so tracking of trains using a special device integrated in the train seems to be a better possibility. This integrated device would then warn the train driver to drive safely and also enable periodically updating its location status in a remote controller. In this paper we propose such a real time train tracking system using the global positioning system (GPS) and communication of information through Ethernet Concepts. The system proposed enables communicating the real time information about the train position and also its health conditions based on few sensors integrated. The proposed system would also provide the complete information about the different trains running, in the video terminal of the controller, using the available internet facilities and the Google mapping Concepts. This proposed system uses a Arduino - A Electronic open Source hardware which provides the complete computation capability for this work. It is felt that this proposed system would provide a solution for a big organisation like Indian railways to enable monitoring all their train movements in one place by using the internet or through various LAN networks. The locations/positions of all individual vehicles are mapped using their IP addresses, in the Google map wherein each point in the Google map plot provides the current information about the trains and also the Drivers Alcohol status, max speed, GPS Coordinates etc. The design details are provided in the paper.

IRCTC-Railway ticket generation using QR code in Android

https://www.researchgate.net/publication/359256287_IRCTC-RAILWAY_TICKET_GENERATION_USING_QR_CODE_IN_ANDROID

The Railway Ticket generation using android is basically derived from the computer reservation system and upgraded to android-based ticket generation using QR Code. Railway Ticket generation System contains the details about train schedules and its fare tariffs, passenger reservations and ticket records. A Railway inventory contains all train details with QR Code Information. The online QR Based ticket generation system has its database centrally located which is accessed through an Application Programming Interface (API). With the Railway management system the traveller and the train got the freedom to get a ticket without standing in a queue. For travelling in the unreserved section, the passengers have to stand in a queue to get the ticket. In our system, the passenger can generate the unreserved ticket through their android phone itself. The passenger can get the train details by scanning the QR code of a train to get the ticket. The passenger can get a ticket by entering the number of seats and payment details. It has also become a hassle-free transaction for both the train and the traveller. The Railway reservation system involves three main actors: the database, online operator and a database scheduler. The database scheduler updates the database, one of the core functions of the inventory management of railway reservation systems is the

inventory control. Inventory control steers how many seats are available for the booking in the unreserved section.

Smart Ticketing System for Railways in Smart Cities using Software as a Service Architecture

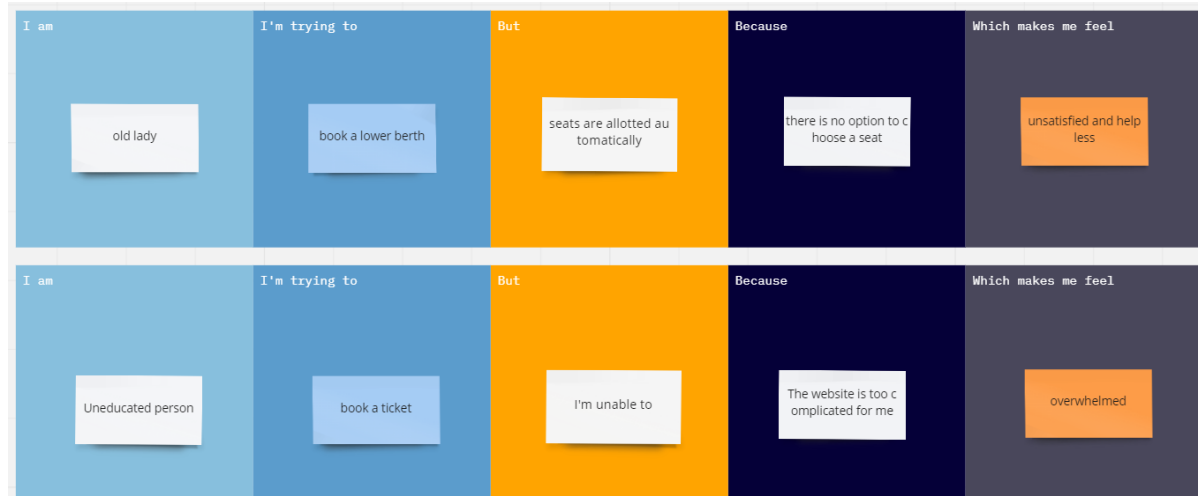
https://www.researchgate.net/publication/320252621_Smart_ticketing_system_for_railways_in_smart_cities_using_software_as_a_service_architecture

Ticketing system for railways was introduced in order to authenticate and authorise valid commuters to suit one's comfort, purpose or needs while travelling. Due to increased commute, travelling by train increased immensely, which resulted in various . Moreover, in spite of having such a massive amount of data generated of the commuters, very poor analysis was ever done to improve the railway service and the commuter’s experiences. To overcome the above pitfalls this paper proposes a smart ticketing system architecture for railways which completely scraps the idea of paper tickets and harnesses the amount of money commuters have invested for their travelling. The commuters will be benefited with the provision of using the seasonal tickets as per their requirements depending on the number of days they have subscribed. This model also enables the authorities to detect those commuters who never pay and buy or fail to carry their tickets or pass while travelling. The proposed system will also have features like crowd analysis and suggesting cost effective offers to the railway commuters.

2.3 Problem Statement Definition

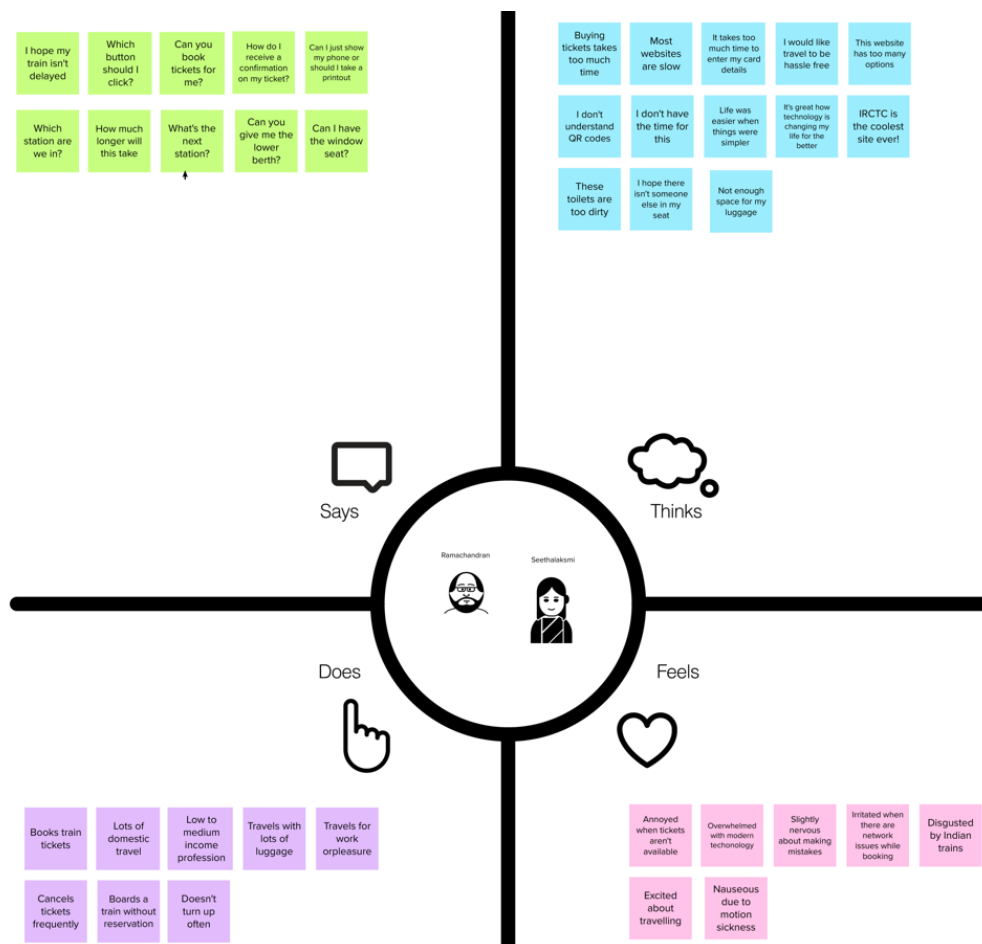
How to improve passenger’s travel experience, assure their safety, remove any confusion, mitigate the effects of delays and use latest technology instead of traditional methods of printed tickes and manual verification?





3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

PROBLEM

How might we improve passenger's travel experience, assure their safety, remove any confusion, mitigate the effects of delays and use latest technology instead of cumbersome traditional methods such as a printed ticket?

Team Lead - 2019103585

Automatic call to the passenger 10 minutes before the destination arrives.

Book auto/cabs while nearing the destination.

Providing a provision for ordering food via the booking app.

Check the passenger's location before starting at each station to make sure he/she is inside the train.

Team Member 1 - 2019103561

Create a more intuitive website with proper UI/UX.

Use QR/Rfid for ticket verification.

Use GPS data to analyze delays and optimize timings.

Allow users to call for help/train halt through the app in case of emergency.

Team Member 2 - 2019103540

Track the station that the passenger is in using GPS and share live location in the app.

Suggest nearby tourist attractions based on passenger's destination.

Notify the users with proper destination and arrival time of the trains.

Suggest nearest bus stops to users from their present train stations.

Team Member 3 - 2019103504

Smoke detectors installed in trains to prevent massive fires.

Reminders containing information about their journey can be sent to the passengers at a chosen interval.

In case of a train being cancelled or halted before the entire journey is complete, alternative travel suggestions can be made.

Allow passengers to choose specific seats or allot seats according to passenger's needs such as lower berths for senior citizens.

Location Based Services

Automatic call to the passenger 10 minutes before the destination arrives

Book auto/cabs while nearing the destination.

Check the passenger's location before starting at each station to make sure he/she is inside the train.

Use GPS data to analyze delays and optimize timings.

Track the station that the passenger is in using GPS and share live location in the app.

Suggest nearest bus stops to users from their present train stations.

Suggest nearby tourist attractions based on passenger's destination.

Notify the users with proper destination and arrival time of the trains.

Improved safety measures

Allow users to call for help/train halt through the app in case of emergency.

Smoke detectors installed in trains to prevent massive fires.

Reminders and Notifications

Notify the users with proper destination and arrival time of the trains.

Reminders containing information about their journey can be sent to the passengers at a chosen interval.

Automatic call to the passenger 10 minutes before the destination arrives

User experience improvements

Create a more intuitive website with proper UI/UX.

Use QR/Rfid for ticket verification.

In case of a train being cancelled or halted before the entire journey is complete, alternative travel suggestions can be made.

Allow passengers to choose specific seats or allot seats according to passenger's needs such as lower berths for senior citizens.

Providing a provision for ordering food via the booking app

		<ul style="list-style-type: none"> ● Use of latest technology instead of cumbersome traditional methods such as printed tickets.
2.	Idea / Solution description	<ul style="list-style-type: none"> ● A Web page designed for the public to book tickets based on availability and convenience. ● The portal generates a QR code on booking and is used for verification while boarding. It basically serves as an E-ticket. ● A GPS module is used in the train to track it and update the live status of the journey continuously through the App. ● All the booking details of the customers will be stored in the database with a unique ID and retrieved back when the Ticket Collector scans the QR Code.
3.	Novelty / Uniqueness	<ul style="list-style-type: none"> ● Using data from the GPS to analyze delays and optimize arrival and departure timings of trains. ● Providing a provision for ordering food via the app. ● Providing an interface to book auto/cabs while nearing the destination. ● Checking the passenger's location before starting at each station to make sure he/she is inside the train. ● Suggesting alternative travel options incase of cancellation of trains. ● Sending reminders to each passenger regarding their journey. ● Smoke detectors to detect and hence prevent massive fires.
4.	Social Impact / Customer Satisfaction	<ul style="list-style-type: none"> ● Passengers will have a single platform for all the travel related requirements. ● Improved safety and security. ● Improved convenience and passenger comfort while travelling.
5.	Business Model (Revenue Model)	<ul style="list-style-type: none"> ● Expand the revenue by partnering with food services and travel agencies. ● Additional features, improved travel experiences, security etc. will attract more customers.
6.	Scalability of the Solution	<p>Integrating all the features in a single webpage is possible and easy to implement.</p> <p>The QR code scanner and GPS module is practical and the set up is simple.</p>

3.4 Problem Solution fit

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS Who is your customer? <ul style="list-style-type: none">• Businessmen• Family with kids• Young adults• Senior citizens• Uneducated people	6. CUSTOMER CONSTRAINTS CC What constraints prevent your customers from taking action or limit their choices of solutions? <ul style="list-style-type: none">• Availability of train.• Availability of required number of seats in a single compartment.• Specific berth availability.• Budget.• Long queues while booking in the absence of network access.• Carrying a physical copy of ticket.• Network connectivity.	5. AVAILABLE SOLUTIONS AS Which solutions are available to the customers when they face the problem <ul style="list-style-type: none">• Early booking expands choice for passengers.• Regular tickets are way cheaper than tatkal tickets.• Booking using IRCTC website.• Showing SMS instead of a physical copy.	Explore AS, differentiate
	2. JOBS-TO-BE-DONE / PROBLEMS J&P <ul style="list-style-type: none">• Track the live status of the arrival and departure of trains.• Losing the ticket.• Information about the cab/auto availability while nearing the destination.• Remind passengers while reaching the destination.• Providing provision for food ordering.	9. PROBLEM ROOT CAUSE RC <ul style="list-style-type: none">• Delayed reach causes inconvenience for the passengers.• Fear of missing the correct station.• Difficulty in carrying the tickets safely.• Difficult in finding auto/cabs when they reach the destination untimely.• Passengers safety.	7. BEHAVIOUR BE What does your customer do to address the problem and get the job done? <ul style="list-style-type: none">• Book the next travel a few hours late.• Keep an alarm.• Carry another copy or show SMS.• Use a third party app for booking in advance.• Sharing live google location to friends or family.	
Focus on J&P, fit into BE, understand RC	3. TRIGGERS TR <ul style="list-style-type: none">• Easier booking.• Ensures more safety.• Food and travel in the same booking app increases the convenience for users.	10. YOUR SOLUTION SL A Web page designed for the public to book tickets based on availability and convenience. The portal generates a QR code on booking and is used for verification while boarding. It basically serves as an E-ticket. A GPS module is used in the train to track it and update the live status of the journey continuously through the App. All the booking details of the customers will be stored in the database with a unique ID and retrieved back when the Ticket Collector scans the QR Code.	8. CHANNELS of BEHAVIOR CH 8.1 ONLINE <ul style="list-style-type: none">- Ticket booking- Use third party app to book tickets- Sharing live location- Use third party apps to monitor train status 8.2 OFFLINE <ul style="list-style-type: none">- Set alarms- Carry another copy- Check seating chart	Focus on J&P, fit into BE, understand RC
	4. EMOTIONS: BEFORE / AFTER EM Insecure > safe Inconvenient > comfortable Impatient > assured			

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

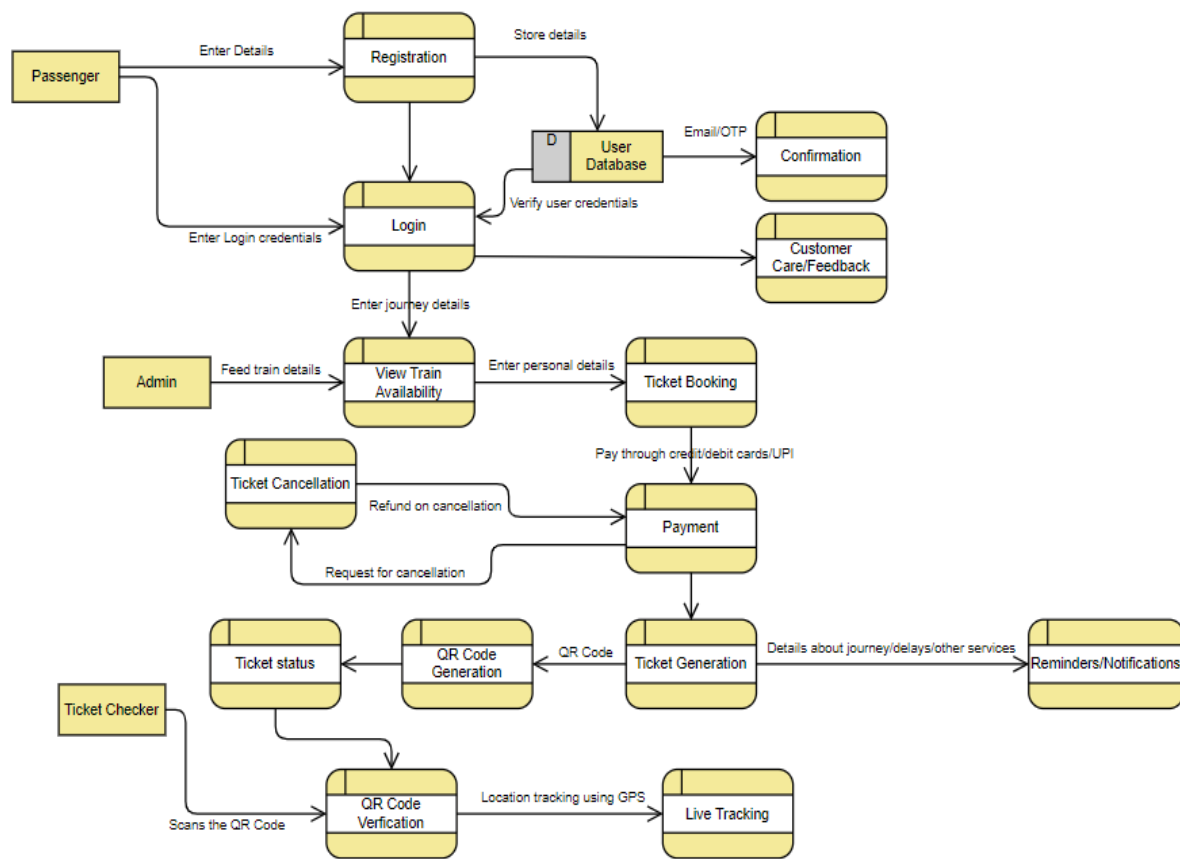
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through Other social media sites such as facebook. Registration through Phone number
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Authentication/Login	Authentication via Login ID and Password Authentication via OTP received on registered phone number
FR-4	Details of Trains	Collect user's start and destination List all trains connecting the above start and destination.
FR-5	Booking of Tickets	Display available classes in the train Collect user's preferred class Display available seats in the train Collect user's preferred seat/berth Allot different seat/berth if preferred seat/berth is not available
FR-6	Initiate Payment	Provide users with different payment options such as credit card/ debit card/ UPI Redirect to the selected payment gateway On successful completion of payment proceed onto FR-7
FR-7	Generate Ticket	Generate E-ticket for the user's journey with all the necessary details and most importantly a QR code used to authenticate the user during their journey
FR-8	Status of Ticket	Display the status of the ticket whether - confirmed/waiting list/RAC
FR-9	Reminders/Notifications	Remind users about their journey a day ahead before the actual journey Notify the users if the status of their ticket changes - such as from waiting list to confirmed or RAC to confirmed Notify the users if the train is cancelled and also provide alternatively available trains
FR-10	Live tracking of Trains	Provide real-time tracking of trains using GPS and make information such as ETA, current stop, unseen delays etc available to users
FR-11	Ticket cancellation	Provide an option to cancel the ticket.

4.2 Non-Functional requirements

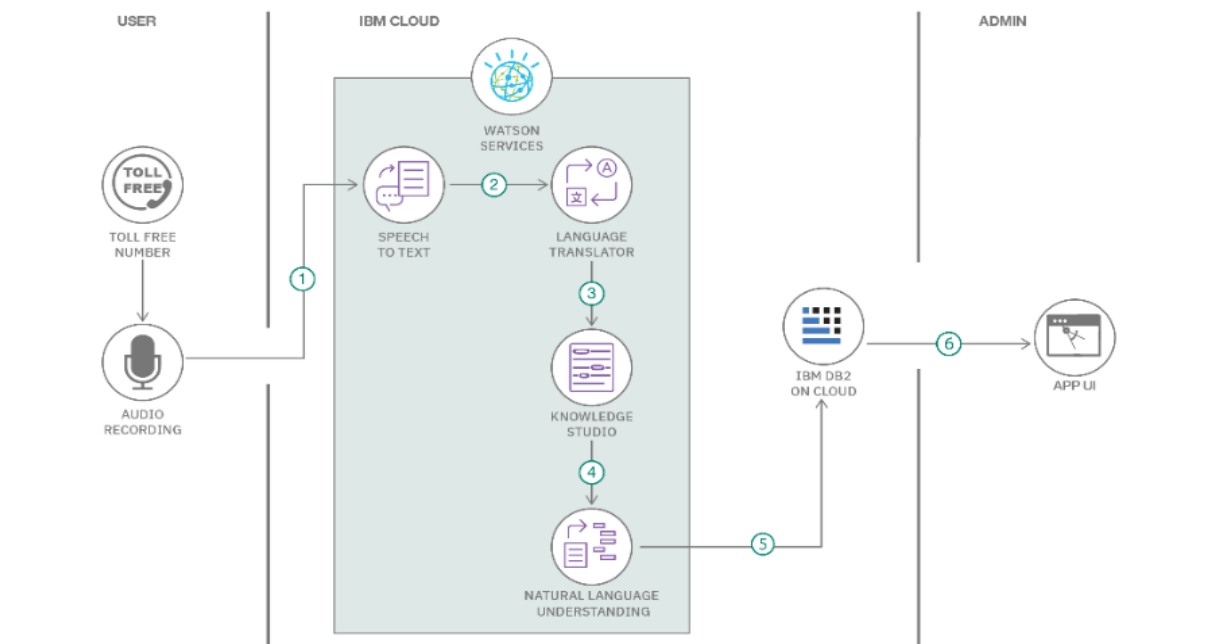
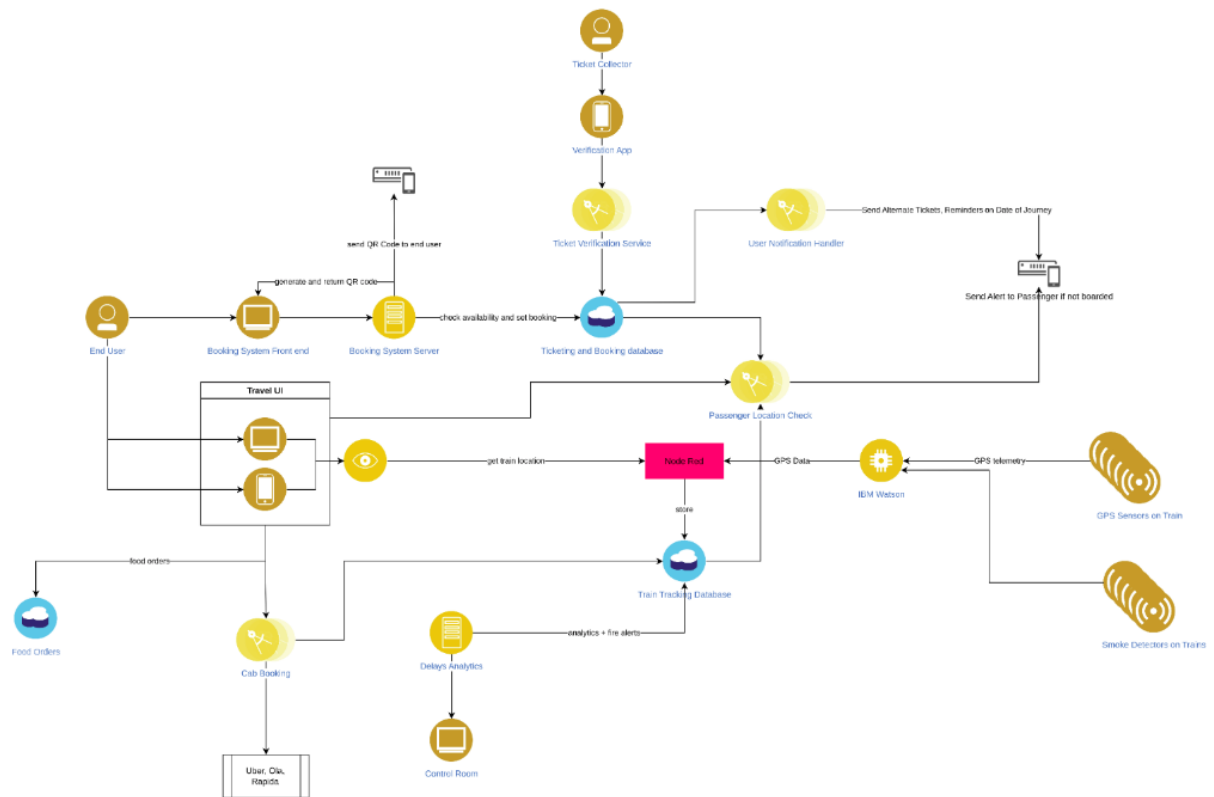
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The web app can easily accessible because of it's sleek and simple user interface
NFR-2	Security	The web app can access only by valid user and password credential. The payment gateway have lot of security
NFR-3	Reliability	In the process booking ticket, passenger may face session timed out or network error.The web app auto save option.Therefore lot of time is saved
NFR-4	Performance	The application is work faster with good network connection
NFR-5	Availability	QR code is sendd through the message and email id or phone number
NFR-6	Scalability	Session management is available for web app. Numerous user can access the web app easily.

5. PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture



5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user, Web user)	Registration	USN-1	As a user, I can register through the form by filling in my details.	I can register and create my account /dashboard	High	Sprint-1
		USN-2	As a user, I can register through phone numbers, gmail, facebook or other social sites.	I can register & create my dashboard with Facebook Login or other social sites	High	Sprint-2
	Confirmation	USN-3	As a user, I will receive confirmation through email or OTP once registration is successful.	I can receive confirmation email & click confirm	High	Sprint-1
	Authentication/Login	USN-4	As a user, I can login via login ID and password or through OTP received on registered phone number.	I can login and access my account/dashboard	High	Sprint-1
	Display train details	USN-5	As a user, I can enter the start and destination to get the list of trains available connecting the above.	I can view the train details(name & number), corresponding routes it passes through based on the start and destination entered.	High	Sprint-1
	Booking	USN-6	As a user, I can provide the basic details such as name, age, gender etc.	I can view, modify or confirm the details entered.	High	Sprint-1
		USN-7	As a user, I can choose the class, seat/berth. If a preferred seat/berth isn't available I can be allotted based on the availability.	I can view, modify or confirm the seats/class/berth selected	High	Sprint-1
	Payment	USN-8	As a user, I can choose to pay through credit card/debit card/UPI.	I can view the payment options available and select my desirable choice to proceed with the payment.	High	Sprint-1
		USN-9	As a user, I will be redirected to the selected payment gateway and upon successful completion of payment I'll be	I can pay through the payment portal and confirm the	High	Sprint-1

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
			redirected to the booking website.	booking.If any changes need to be done I can move back to the initial payment page.		
	Ticket generation	USN-10	As a user, I can download the generated e-ticket for my journey along with the QR code which is used for authentication during my journey.	I can show the generated QR code so that authentication can be done quickly.	High	Sprint-1
	Ticket status	USN-11	As a user, I can see the status of my ticket whether it's confirmed/waiting/RAC.	I can constantly get the information and arrange alternate transport if the ticket isn't confirmed.	High	Sprint-1
	Reminders/Notification	USN-12	As a user, I get reminders about my journey a day before my actual journey.	I can make sure that I don't miss the journey because of the constant notifications.	Medium	Sprint-2
		USN-13	As a user, I can track the train using GPS and can get information such as ETA, current stop and delays.	I can track the train and get to know about the delays and plan accordingly.	Medium	Sprint-2
	Ticket cancellation	USN-14	As a user, I can cancel my ticket if there's any change of plan.	I can cancel the ticket and get a refund based on how close the date is to the commencement of the journey.	High	Sprint-1
	Raise queries	USN-15	As a user, I can raise queries through the query box or via mail.	I can view my previous queries.	Low	Sprint-2
Customer Care Executive	Answer the queries	USN-16	As a user, I will answer the queries/doubts raised by the customers.	I can view the queries and mark it once resolved.	Medium	Sprint-2
Administrator	Feed details	USN-17	As a user, I will feed information about the trains, delays and add extra seats if a new compartment is added.	I can view and ensure the correctness of the information fed.	High	Sprint-1

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

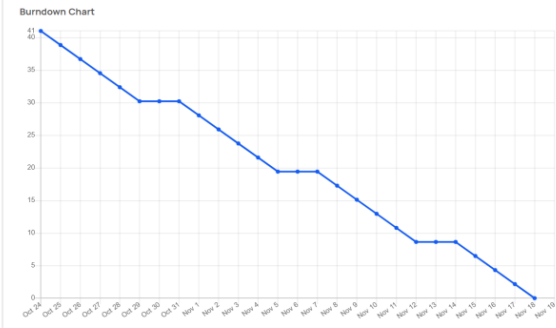
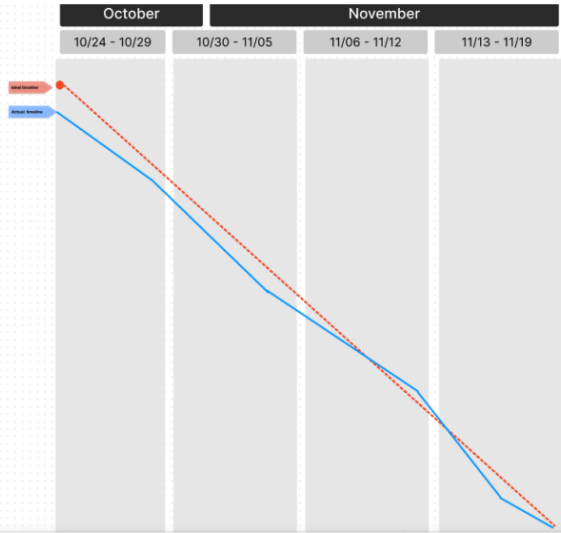
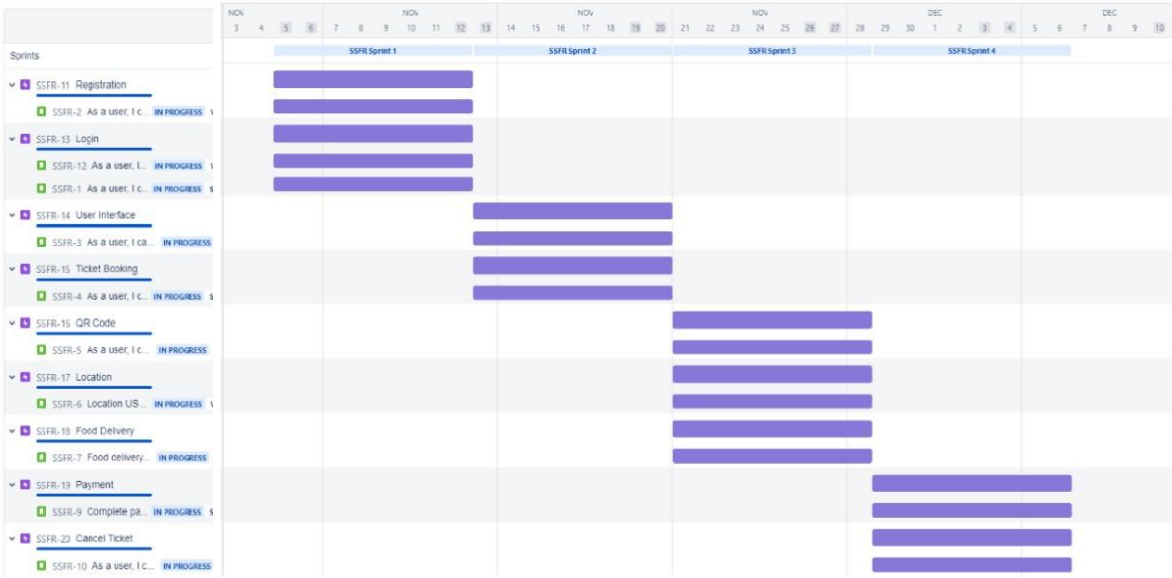
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	User registration	USN-1	As a user, I can register through the form by filling in my details.	3	High	1. Sreeratcha B
Sprint-1	User Login	USN-2	As a user, I can log into the application by entering email & password	3	High	1. Keshikaa R
Sprint-2	User, Train and Booked Tickets Database	USN-3	Database is created to store all the necessary details for the booking.	2	Medium	1. Sreeratcha B 2. Keshikaa R
Sprint-1	Simulation of the tracker device	USN-4	The live location tracker is simulated to check its backend working.	2	Medium	1. Prithivi M 2. Akshaya R
Sprint-1	Ticket Booking System	USN-5	As a user, I can provide my details and book the train ticket, select class/berth based on the availability.	3	High	1. Sreeratcha B 2. Akshaya R 3. Keshikaa R
Sprint-1	Payment portal	USN-6	As a user, I can choose to pay through credit card/debit card/UPI in the portal.	3	High	1. Akshaya R 2. Sreeratcha B
Sprint-1	Ticket generation	USN-7	As a user, I can download the generated e-ticket for my journey	3	High	1. Keshikaa R 2. Akshaya R
Sprint-2	Live train Tracking system	USN-8	As a user, I can view my live location reading through mobile GPS.	3	High	1. Prithivi M 2. Akshaya R
Sprint-2	Alerts, notifications and Reminders	USN-9	As a user, I get reminders about my journey and any emergency alerts.	1	Low	1. Sreeratcha B

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	UI for QR Code Scanner	USN-10	As a user, I can get my ticket verified through the QR code Scanner.	3	High	1. Sreeratcha B 2. Keshikaa R
Sprint-3	Ticket Cancellation	USN-11	As a user, I can cancel my ticket if there's any change of plan.	2	Medium	1. Sreeratcha B 2. Prithivi M
Sprint 3	Web UI Integration	USN-12	Front-End of the Web UI is integrated with the database through the server.	3	High	1. Sreeratcha B 2. Keshikaa R
Sprint-3	GPS module Integration	USN-13	GPS tracking system is connected with the Web Interface.	3	High	1. Prithivi M 2. Akshaya R
Sprint-3	Cloud service	USN-14	Local application infrastructure is incorporated into Cloud services.	2	Medium	1. Prithivi M
Sprint-4	Application Testing	USN-15	The application is tested over various test cases to guarantee that it successfully meets the user requirements.	2	Medium	1. Akshaya R 2. Keshikaa R 3. Prithivi M
Sprint-4	Deployment	USN-16	The final application is deployed on the IBM Cloud and is made available for users.	3	High	1. Prithivi M 2. Akshaya R

6.2 Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	17	6 Days	24 Oct 2022	29 Oct 2022	17	29 Oct 2022
Sprint-2	9	6 Days	31 Oct 2022	05 Nov 2022	9	05 Nov 2022
Sprint-3	10	6 Days	07 Nov 2022	12 Nov 2022	10	12 Nov 2022
Sprint-4	5	6 Days	14 Nov 2022	19 Nov 2022	5	19 Nov 2022

6.3 Reports from JIRA



7. CODING & SOLUTIONING

7.1 Feature 1

QR code scanning

```
1 import cv2
2 import numpy as np
3 import time
4 import pyzbar.pyzbar as pyzbar
5 from ibmcloudant.cloudant_v1 import CloudantV1
6 from ibmcloudant import CouchDbSessionAuthenticator
7 from ibm_cloud_sdk_core.authenticators import BasicAuthenticator
8
9
10 authenticator = BasicAuthenticator ('apikey-v2-key', 'secret')
11 service = CloudantV1(authenticator=authenticator)
12 service.set_service_url ('https://apikey-v2-service-url')
13
14 cap= cv2.VideoCapture(0)
15 font = cv2.FONT_HERSHEY_PLAIN
16
17 while True:
18     _, frame = cap.read ()
19     decodedObjects = pyzbar.decode (frame)
20     for obj in decodedObjects:
21         #print ("Data", obj.data)
22         a=obj.data.decode('UTF-8')
23         cv2.putText(frame,"Ticket", (50, 50), font, 2,(255,0, 0), 3)
24         #print (a)
25         try:
26             response = service.get_document(db= 'booking', doc_id = a).get_result()
27             # print(response)
28             print("Ticket Verified")
29             time.sleep (5)
30         except Exception as e:
31             # print(e)
32             print ("Not a Valid Ticket")
33             time.sleep (5)
34     cv2.imshow ("Frame", frame)
35     if cv2.waitKey (1) & 0xFF == ord ('q'):
36         break
37
38 cap.release ()
39 cv2.destroyAllWindows ()
40 client.disconnect ()
```

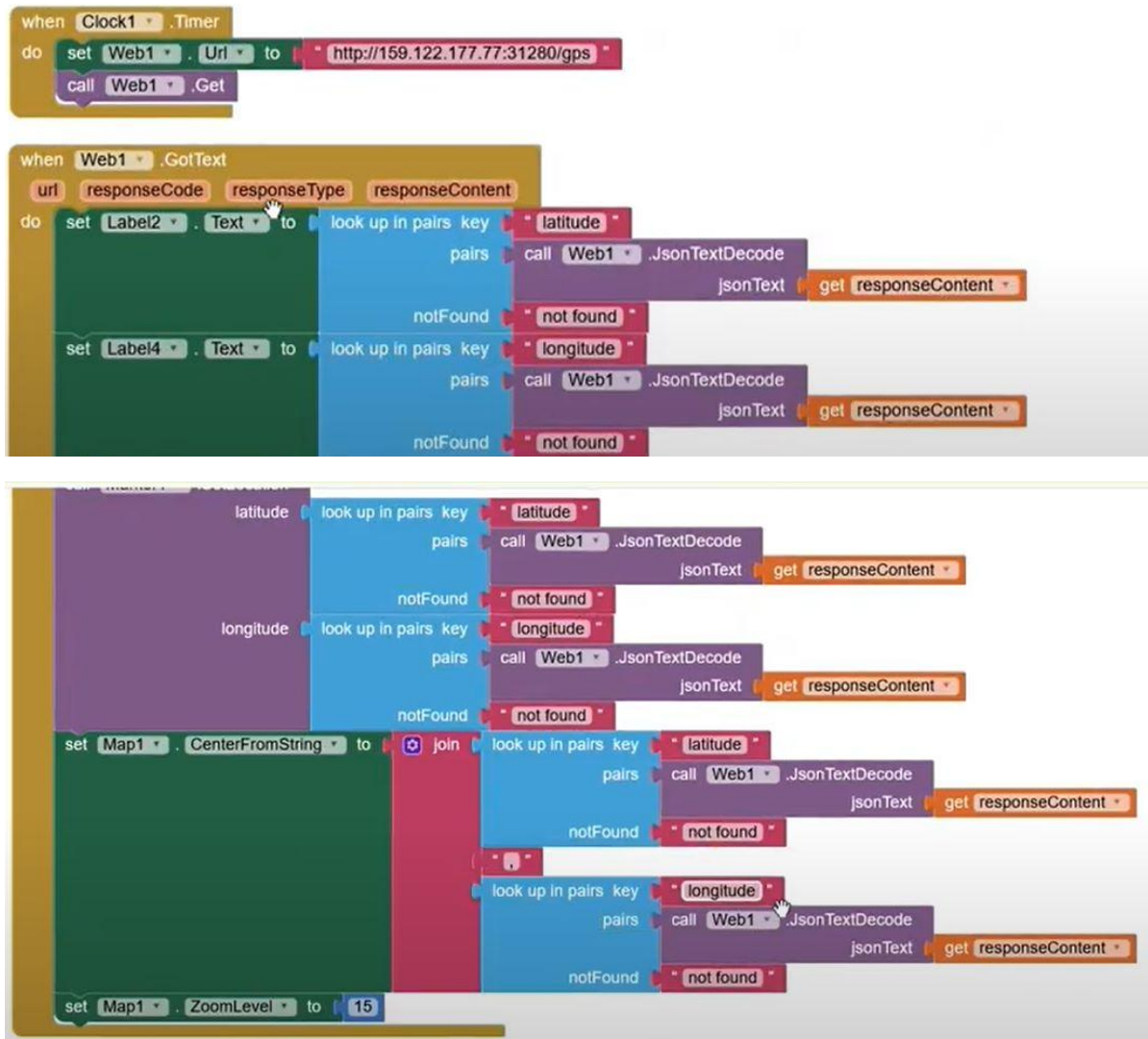
7.2 Feature 2

GPS tracking

```
1 import wiotp.sdk.device
2 import time
3 import random
4
5 myConfig = {"identity":{"orgId": "1xisxi", "typeId": "raspberrypi", "deviceId": "12345"},
6             "auth":{"token": "12345678"}}
7 }
8
9 def myCommandCallback (cmd) :
10     print ("Message received from IBM IoT Platform: %s" % cmd.data['command'])
11     m=cmd. data ['command']
12
13 client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
14 client.connect ()
15
16 def pub (data) :
17     client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0)
18     print ("Published data Successfully: %s", myData)
19
20 while True:
21     myData = {'name': 'Train1', 'lat': 17.6387448, 'lon': 78.4754336}
22     pub(myData)
23     time.sleep(2)
24     myData = {'name': 'Train1', 'lat': 17.6341908, 'lon': 78.4744722}
25     pub(myData)
26     time.sleep(2)
27     myData = {'name': 'Train1', 'lat': 17.6340889, 'lon': 78.4745052}
28     pub(myData)
29     time.sleep(2)
30     myData = {'name': 'Train1', 'lat': 17.6248626, 'lon': 78.4720259}
31     pub(myData)
32     time.sleep(2)
33     myData = {'name': 'Train1', 'lat': 17.6188577, 'lon': 78.4698726}
34     pub(myData)
35     time.sleep(2)
36     myData = {'name': 'Train1', 'lat': 17.6132382, 'lon': 78.4707318}
37     pub(myData)
38     time.sleep(2)
39     client.commandCallback = myCommandCallback
40
41 client.disconnect()
```

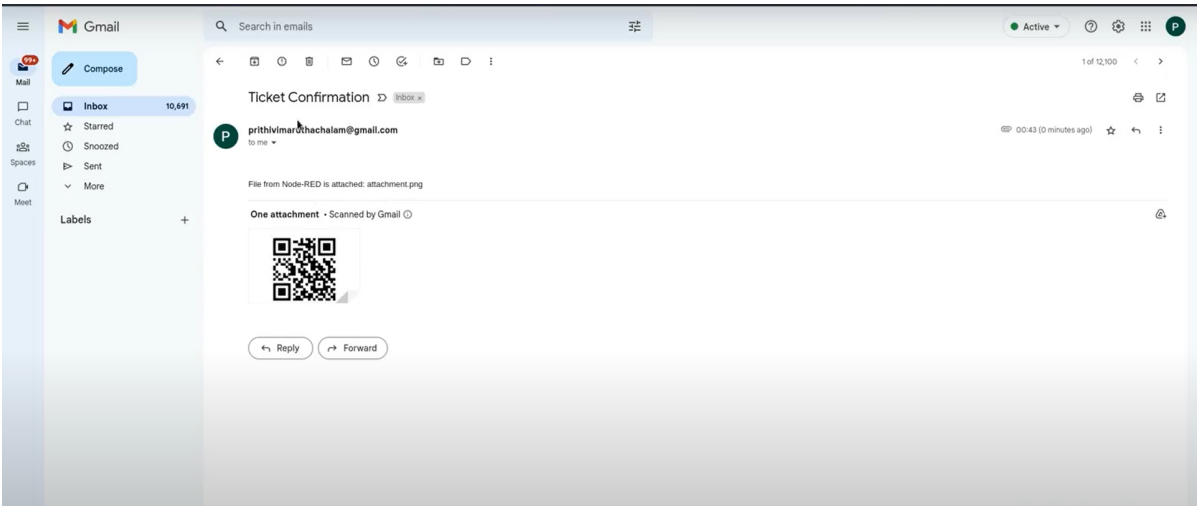
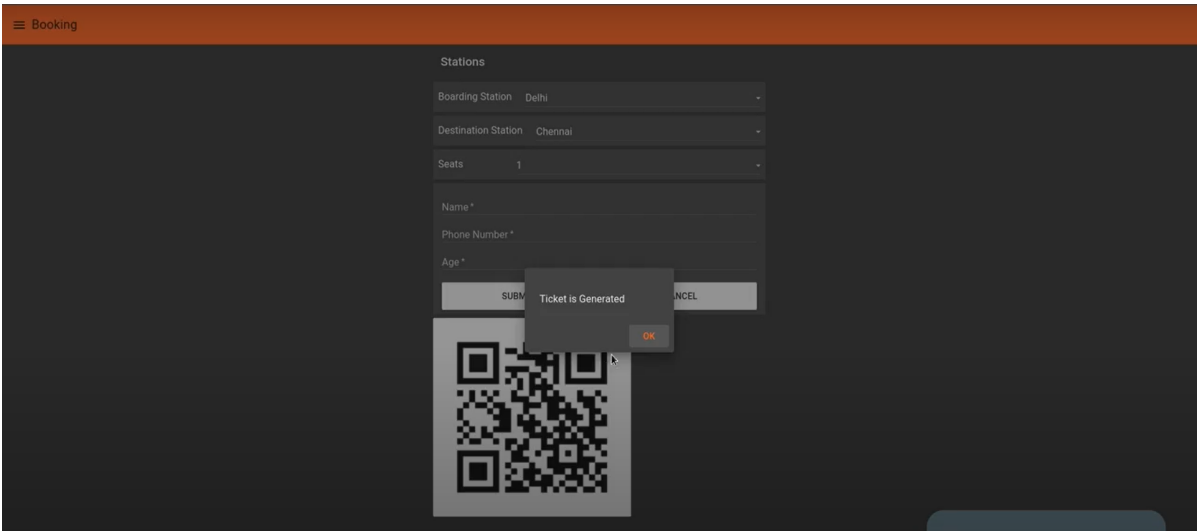
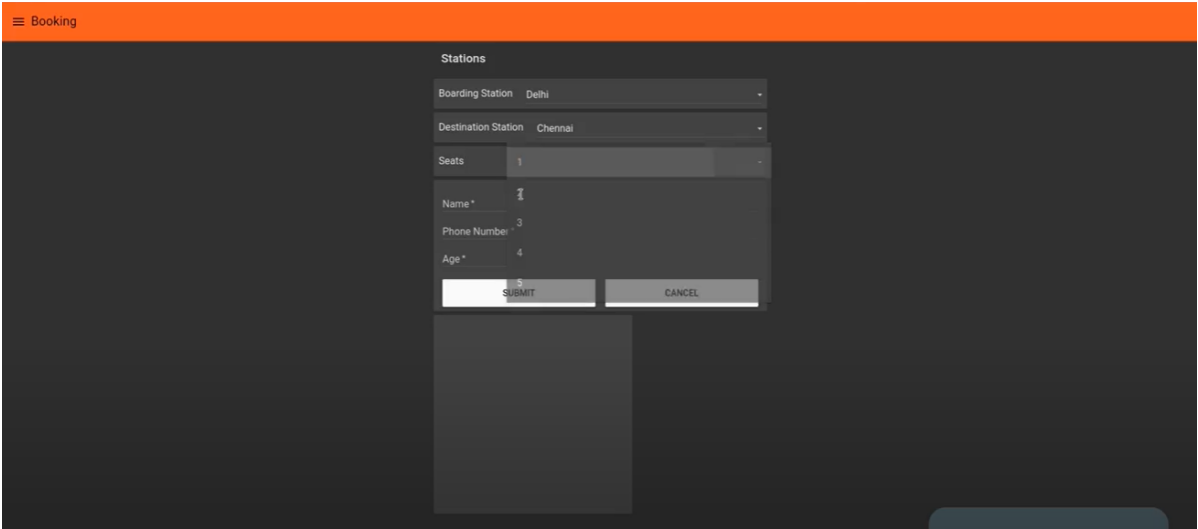
7.3 Feature 3

Mobile App



7.4 Feature 4

Webpage



8. TESTING

8.1 Test Cases

				Date	16-Nov-22								
				Team ID	PM120221AME05329								
				Project Name	Project - Smart Solutions for Railways								
				Maximum Marks	4 marks								
Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation (Y/N)	BUG ID	Executed By
TC_01	Functional	Scanner	Scan Generated QR code	Application on phone/website	1. Open App 2. Scan QR Code	QR Code	Go to Tracking Screen	Working as expected	Pass	-	-	-	1. Prithvi M
TC_02	Exception Reporting	Login	Make sure all criteria are met before booking	Application on phone/website	1. Open App 2. Enter Details (Not everything is required)	Train stop station(No information about the station)	Throw error	Working as expected	Pass	-	-	-	1. Sreenatcha B
TC_03	Exception Reporting	Scanner	Ignore invalid QR	Application on phone/website	1. Open App 2. Scan QR Code	QR Code	Display "Invalid QR Code"	Working same as expected	Pass	-	-	-	1. Akshaya R
TC_04	Functional	Database	Ensure correct data is fetched	Application on phone/website	1. Login 2. Check Database	Any valid information	Any detail that was provided should be present in the database	Working same as expected	Pass	-	-	-	1. Keshikaa R
TC_05	Functional	Database	Ensure mails are sent	Application on phone/website	1. Login 2. Check Mail	Any valid information	Mail should be sent to user	Working same as expected	-	-	-	-	1. Sreenatcha B
TC_06	Functional	Login	Ensure code works instead of QR	Application on phone/website	1. Open App 2. Provide code instead of QR	Code	Go to Tracking Screen	Working same as expected	-	-	-	-	1. Prithvi M

8.2 User Acceptance Testing Defect Analysis

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	6	2	1	0	9
Duplicate	1	0	0	0	1
External	1	2	0	1	4
Fixed	7	2	4	2	15
Not Reproduced	0	0	0	0	0
Skipped	0	0	0	0	0
Won't Fix	0	0	0	0	0
Totals	15	6	5	3	29

Test Case Analysis

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	4	4	0	4
Client Application	2	2	0	2
Security	6	6	0	6

9. RESULTS

9.1 Performance Metrics

NFT - Risk Assessment										
S.No	Project Name	Scope/Feature	Functional Changes		Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score	Justification
1	UI Code Generation	None	High	No Changes	Minority	Score	1.5 to 10%	25/100	25 out of generation is the project's main functionality.	
2	UI Code Checking	None	High	No Changes	High	Score	1.5 to 10%	25/100		
3	NFT App Interface	None	Minority	No Changes	Minority	Score	1.5 to 10%	25%		
4	API's Tracking	None	High	No Changes	High	Minority	1.5 to 10%	25/100		
5	Admin Panel UI	None	High	No Changes	High	Score	1.5 to 10%	25/100		
NFT - Detailed Test Plan										
S.No	Project Overview	NFT Test approach			Assumptions/Dependencies/Tools			Approvals/SignOff		
1	UI Code Generation	User testing for testing performance under load and high volume.			It is assumed that people have a decent internet connection for downloading the UI Code.			Approved		
2	UI Code Checking	User testing for testing performance under load and high volume.			It is assumed that a user enters with incorrectly credentials to test.			Approved		
3	NFT App Interface	User testing for testing performance under load and high volume.			None			Approved		
4	API's Tracking	User testing for testing performance under load and high volume.			It is assumed that people have an understanding of basic mapping and map UI.			Approved		
5	Admin Panel UI	User testing for testing performance under load and high volume.			It is assumed that people have decent internet connection.			Approved		
End Of Test Report										
S.No	Project Overview	NFT Test approach		NFT - Met	Test Outcome	GO/NO-GO decision	Recommendations	Identified Defects (Closed/Open)		Approvals/SignOff
1	UI Code Generation	User testing for testing performance under load and high volume.		None	Substantial chance for success.	GO	Integrating everything together and adding a proper database.	No major defects detected.		Approved

10. ADVANTAGES & DISADVANTAGES

Advantages

1. Scale the system according to the application needs.
2. Automate parts of the system monitoring application, leading to better performances and low operation cost.

Disadvantages

1. Data processing, reduction, and analysis in local controllers and subsequent sending of that data to the cloud , for the further monitoring.

11. CONCLUSION

This project provides a simple User interface for train ticket booking and QR code generation instead of ticket generation. The app shows the live location of trains to passengers. The project is cost effective and efficient.

12. FUTURE SCOPE

CCTV systems can be used for monitoring the videos captured from the track. It will increase the security for passengers and railways. GPS can be used to track the exact location of train for emergency purposes.

13. APPENDIX

13.1 Source Code

<https://github.com/IBM-EPBL/IBM-Project-25922-1659977429>

13.2 GitHub & Project Demo Link

<https://github.com/IBM-EPBL/IBM-Project-25922-1659977429>

<https://drive.google.com/file/d/1H61TnPKDRNZY9ZqhbOpXRbklRJNereyM/view?usp=sharing>