SMART SOLUTION FOR RAILWAYS

A PROJECT REPORT

TEAM ID

PNT2022TMID35177

TEAM MEMBERS

ARUN TIILAK KARTHE

SRI PRIYAN S

HARISH J

BHARATH KUMAR D P

COLLEGE OF ENGINEERING, GUINDY

ANNA UNIVERSITY : CHENNAI 600 025

NOVEMBER 2022

CONTENTS

1 INTRODUCTION

1.1 PROJECT OVERVIEW

Smart Solutions for railways is designed to reduce the work load of the user and also the use of paper. It provides a web page designed for the public where they can book tickets after seeing the available seats. After booking tickets, the person will get a QR code which can be used for verifying the ticket by the Ticket Collector. A GPS module is present in the train to track it. The live location of the train is updated to the users in the web app continuously, thus enabling users to know the real-time location of the train and estimate the arrival time.

1.2 PURPOSE

Passengers have to carry a physical ticket which may get lost, leading to unnecessary delays and hardships. The software allows verification via QR codes, which speeds up the process tremendously.

Passengers who are on a hurry may not have enough time to wait for the train indefinitely. The live location of the train can help them make the decision to wait or take some other mode of transport.

2 LITERATURE SURVEY

2.1 EXISTING PROBLEM

The authors of [1] have worked to create Android Suburban Railway (ASR) ticketing, mainly to buy suburban tickets which is the most challenging when compared to booking the long journey tickets through 'M-ticket', since 'M-tickets' often fail with suburban (local travel) tickets. ASR tickets can be bought with just a smartphone application, where you can carry your suburban railway tickets on your smartphone as a QR (Quick Response) code. It uses the

smartphone's "GPS" facility to validate your ticket. The user's ticket information is stored in a CLOUD database for security purposes which is missing in the present suburban system. Also, the ticket checker is provided with a checker application to search for the user's ticket with the ticket number in the cloud database for checking purposes.

In [2], the issues surrounding data capture and transmission to a storage system, powering of onboard systems, and the analysis of data and the distribution of information derived from the data are discussed. The advancements made in communication tools help in providing the actual condition and tracking of the rail vehicles in real-time to customers and entities in charge of maintenance by transmitting all the captured data to effective web-based applications and monitoring platforms that can be accessed through PC, tablets, or even smartphones.

[3] focuses on different communication technologies under the paradigm of IoT. The broadband communication technologies like Global System Mobile Communications- Railway (GSM-R), Long Term Evaluation (LTE), fifth generation (5G), IEEE 802.11 and Wireless Sensor Networks (WSN). In India, UIDAI Aadhar is used in this system in the process of booking tickets. The smart railway reservation database is maintained by two databases; one is the railway database and another one is maintained by UIDAI. It is efficient to use these two databases and perform a query service between two databases. Tickets are stored with the help of an Aadhar number and are verified utilizing the databases available.

The system proposed by [4] reforms the current ticket booking process for Suburban Railway. With the help of this application, travellers will be able to book their tickets through their mobile using Wi-Fi connectivity. It can also keep the track of most recent ticket purchases. This is an effort towards a queue-less ticket booking system and helps passengers utilize their time efficiently, which is

wasted waiting in these queues. This system provides the facility and flexibility to book tickets using restricted Wi-Fi zones available on platforms. The provided Android application can be only accessed within the Wi-Fi zones only. After ticket booking, tickets will be downloaded directly on smartphones.

In the Indian Railways transport system and most other public transport systems, a passenger cannot book a ticket after the charting of the train is done. A seat remains unused if a passenger does not board a train or cancels his ticket after the charting of the train is done. The approach taken by [5] to overcome this issue is by using a dynamic seat allocation system that employs a QR Code containing the URL to an online website for railway reservations. In the QR code, a passenger-specific URL is stored. When a hand-held terminal device running on android OS reads this URL during the check-in of a passenger, the status of the seat is updated in the central database. Any passenger who doesn't

board the train would imply that their QR code check-in procedure was not completed, and after a specified time interval the ticket for that seat is automatically made available in the system for booking to other passengers.

To track the real-time positions of trains, the authors of [6] propose a system that enables the communication of real-time information about a train's position. By reading the data provided by all running trains, a complete network of each active train and its real-time position is obtained. The system uses an Arduino to provide the required computational power. The GPS module connected to the Arduino reads satellite data in accurately identify its current position. Using this data, the Arduino can compute the train's current latitude, longitude and speed of motion. An Ethernet Shield is used to provide each train with a static IP address. The remote user who wishes to track a train's position types in the IP address of the train in their web browser, which opens up the control panel for the train's Arduino and allows the user to view information regarding the train's position and speed.

2.2 REFERENCES

[1] S. Karthick and A. Velmurugan, "Android suburban railway ticketing with GPS as ticket checker," 2012 IEEE International Conference on Advanced Communication Control and Computing Technologies (ICACCCT), pp. 63-66, 2012.

[2] C. Ulianov, P. Hyde and R. Shaltout, "Railway Applications for Monitoring and Tracking Systems," Marinov, M. (eds) Sustainable Rail Transport. Lecture Notes in Mobility. Springer, Cham., 2018.

[3] B. Mallikarjuna, A. K. R. Doddi and G. Sailaja, "Enhanced Railway Reservation System using Internet of Things," 2018 IADS International Conference on Computing, Communications & Data Engineering (CCODE), 2018.

[4] G. Shelar, V. Rathod and S. Patil, "Railway Ticket Booking System with Restricted Wi-Fi Zone," International Journal of Trend in Scientific Research and Development (ijtsrd), vol. 2, no. 4, pp. 611-615, 2018.

[5] Swarup, M. Mohan, A. Dwivedi, C. Sonkar, R. Prasad, M. Bag and V. Singh, "A QR code based processing for dynamic and transparent seat allocation in Indian railway," nternational Journal of Computer Science Issues (IJCSI) 9, no. 3 (2012), p. 338, 2012.

[6] R. I. Rajkumar, P. E. Sankaranarayanan and G. Sundari, "GPS and Ethernet based real time train tracking system," 2013 International Conference on Advanced Electronic Systems (ICAES), pp. 282-286, 2013.

2.3 PROBLEM STATEMENT DEFINITION

Who does the problem affect?

Passengers, Voyagers.

What are the boundaries of the problem?

Railway ticket booking system that generates a unique QR code for each ticket. Tracking the live location of trains using the GPS.

What is the issue?

Passengers cannot choose the seats they prefer. They have to carry a physical ticket which may get lost. Passengers who got to go quick may not have enough time to wait for the train indefinitely. The live location of the train can help them make the decision to wait or take some other mode of transport.

When does the issue occur?

All the time.

Where is the issue occurring?

Existing Train booking systems, train and in railway stations.

Why is it important that we fix the problem?

Railway is one of the most common modes of transport. Improving the user experience is very important. An efficient way to check the tickets is of top priority.

Case Studies

1. Arun is a trekker and likes long distance travelling. His preferred mode of transport is Railways as it is cost effective. He wants to enjoy his journey along the way. So, he wants the window seat to adore the nature while travelling.

2. Bharath is a very busy guy and goes from one place to another frequently. He needs a way to minimize the time he waits between the travels so that he finishes his work quickly.

3. KG is a forgetful guy and the only thing he carries all the time is his iPhone. As a result, he likes to have the train ticket in the digital form in his mobile so that he has one less thing to worry about forgetting.

4. HP is a TTE and he wants to verify if the tickets are legitimate reliably and quickly so that he can check a greater number of passengers, reducing the possibilities of travelling without the ticket and escaping the fine.

3 IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS
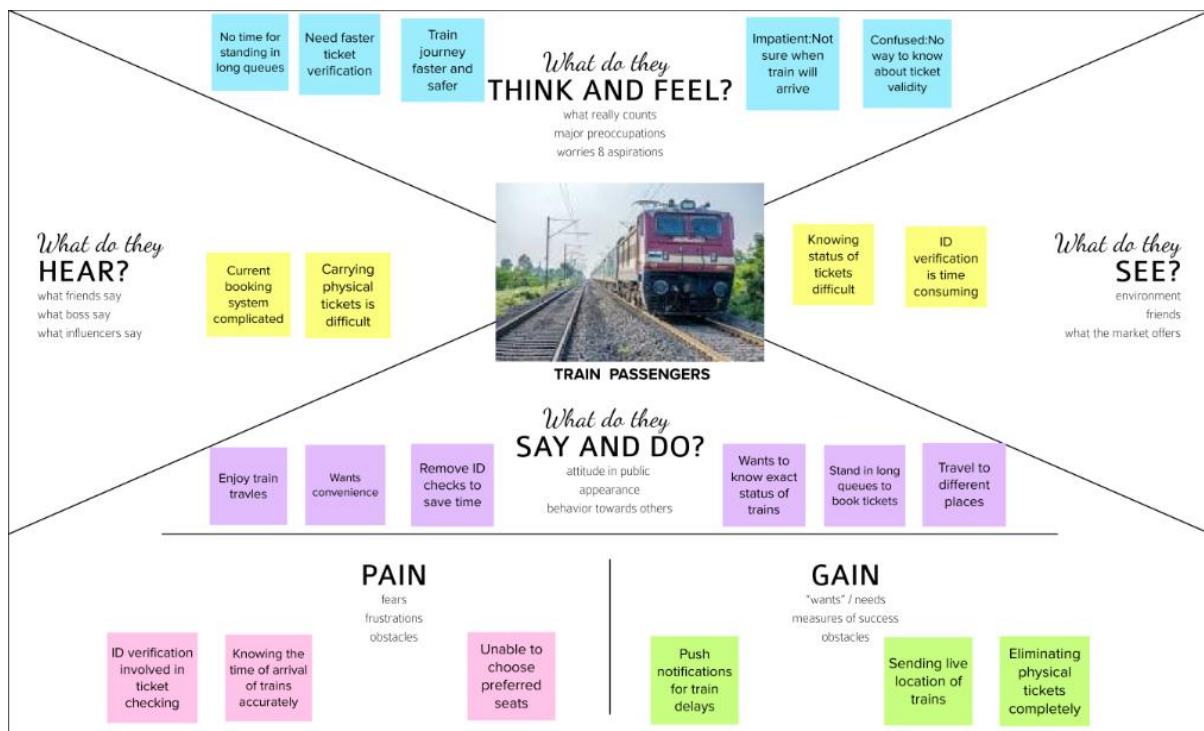
3.2 IDEATION & BRAINSTORMING

Internet of Things

- Regulate coach temperature in AC coaches using temperature sensors
- Monitor track condition through sensors

Machine Learning

- Berth suggestion based on passenger details
- Predict chances of confirmation of tickets in waiting list

Web Interface

- Send platform information through text messages
- Bookmyshow style ticket booking
- Crash detection and sending SOS messages to first responders
- Pre-book food for train journey
- Contact information of doctors at next station in case of emergency
- Push notifications for train reminders
- Share live location of trains
- Easy access for train drivers to seek medical help
- Push notification for train delays and alternate trains
- Get passenger feedback regarding issues in journey
- Reminders for train maintenance

Cloud

- Upload the ID cards needed for verification to cloud

3.3 PROPOSED SOLUTION

Solution description

Using GPS modules to provide users with the train's location and estimated time of arrival. A web UI will be used as a portal for users, which also generates unique QR codes on successful ticket booking. QR codes can be used to streamline the ticket verification process

Novelty/Uniqueness

1. Using ML for predicting if the ticket will get confirmed from the waiting list
2. Improving the security of the QR code and the date stored
3. Regulating temperature in AC coaches
4. Crash detection and sending SOS to first responders

Social Impact / Customer Satisfaction

1. Trust of users on Railways increases
2. Accidents will be reduced
3. Users will save time and plan their work accordingly

Business Model

Offering Yearly/Monthly Subscription based model to the competent Railway Authorities.

Scalability of the Solution

1. The solution uses off the shelf technologies and no specialized software in used
2. Hardware requirements involve only a QR code scanner and GPS module which can be installed on the trains

3.4 PROBLEM SOLUTION FIT

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS Passengers, Voyagers who wish to travel to different locations	6. CUSTOMER CONSTRAINTS CC Passengers cannot choose the seats they prefer. They have to carry a physical ticket which may get lost. Passengers who got to go quick may not have enough time to wait for the train indefinitely.	5. AVAILABLE SOLUTIONS AS Passengers can take multiple physical copies of a ticket to prevent losing them TTE will have to manually verify the identity of each passenger	Explore AS, differentiate
Focus on J&P, tap into BE, understand RC	2. JOBS-TO-BE-DONE / PROBLEMS J&P The live location of the train must be easily accessible by the users Ticket verification must be streamlined Unnecessary documents should not be carried by passengers	9. PROBLEM ROOT CAUSE. RC Train booking infrastructure is outdated Popularity of train travel has exploded Trains are rarely on schedule	7. BEHAVIOUR BE Bring original documents on train rides Take multiple copies of train tickets Arrive at station early to ensure they don't miss the train	Focus on J&P, tap into BE, understand RC
	3. TRIGGERS TR Holidays Neighbours going on vacation Work-related travel 4. EMOTIONS: BEFORE / AFTER EM Confident -> Confused: No way to know about the validity of the ticket Excited -> Impatient: Not sure when train will arrive Energetic -> Tired: TTE ticket verification takes too long per person	10. YOUR SOLUTION SL Using GPS modules to provide users with the train's location and estimated time of arrival. A web UI will be used as a portal for users, which also generates unique QR codes on successful ticket booking. QR codes can be used to streamline the ticket verification process.	8.CHANNELS of BEHAVIOUR CH 8.1 ONLINE Ticket booking through IRCTC website 8.2 OFFLINE Arriving at station early to check train status Verifying passenger's ID proof	Identify strong TR & EM

4 REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

The functional requirements are given in Table 1.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via Mobile OTP

FR-3	Journey Details	The system must enable the users to search for the available trains with the expected time of arrival and travel for a given source and destination.
FR-4	Ticket Booking	The system must allow the users to book Railway tickets for the seats they prefer.
FR-5	Payment Gateway	The system must provide the payment gateway, usingwhich the users can pay the price of the tickets that they booked.
FR-6	Ticket Verification	The system must generate a unique QR code for each booked ticket and store it in the database so that it canbe verified by the Train Ticket Examiner.
FR-7	Live Tracking the Train	The system must track the location of the trains in realtime and make it accessible to the users.
FR-8	Push Notification	The system must send push notification to the passengers in case there is a delay in the arrival of thetrain.
FR-9	Waiting List	The system must show the probability that a ticket will be confirmed from the waiting list.

Table 1: Functional Requirements

5 PROJECT DESIGN

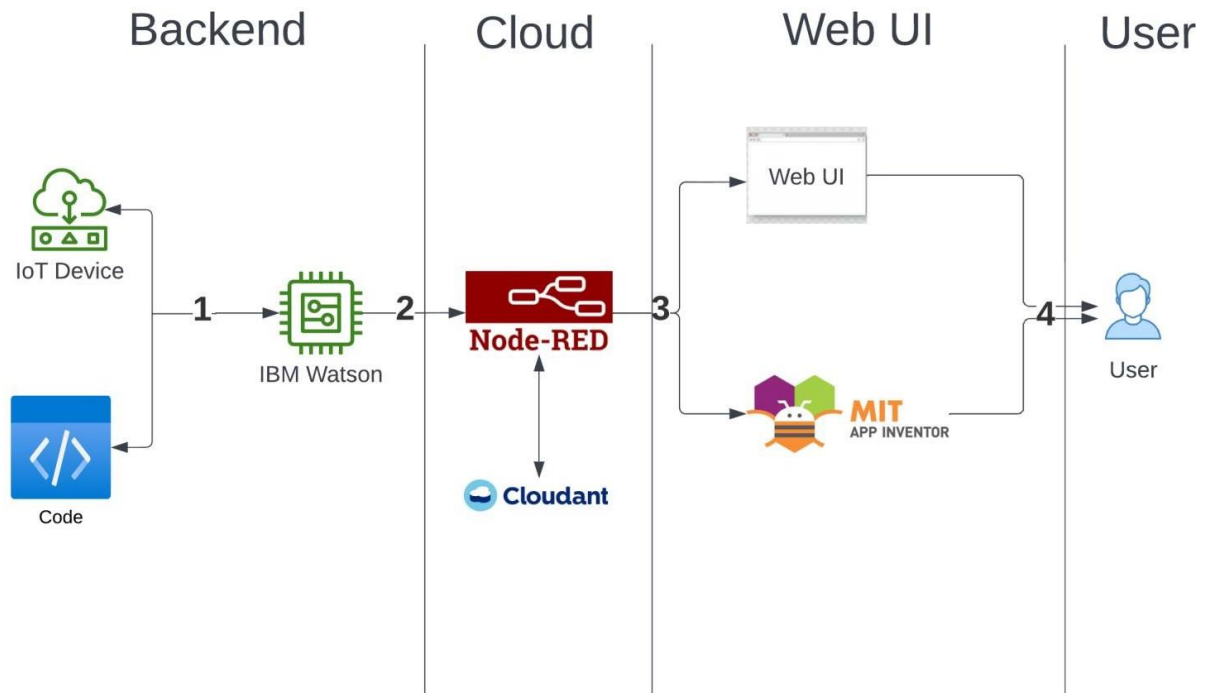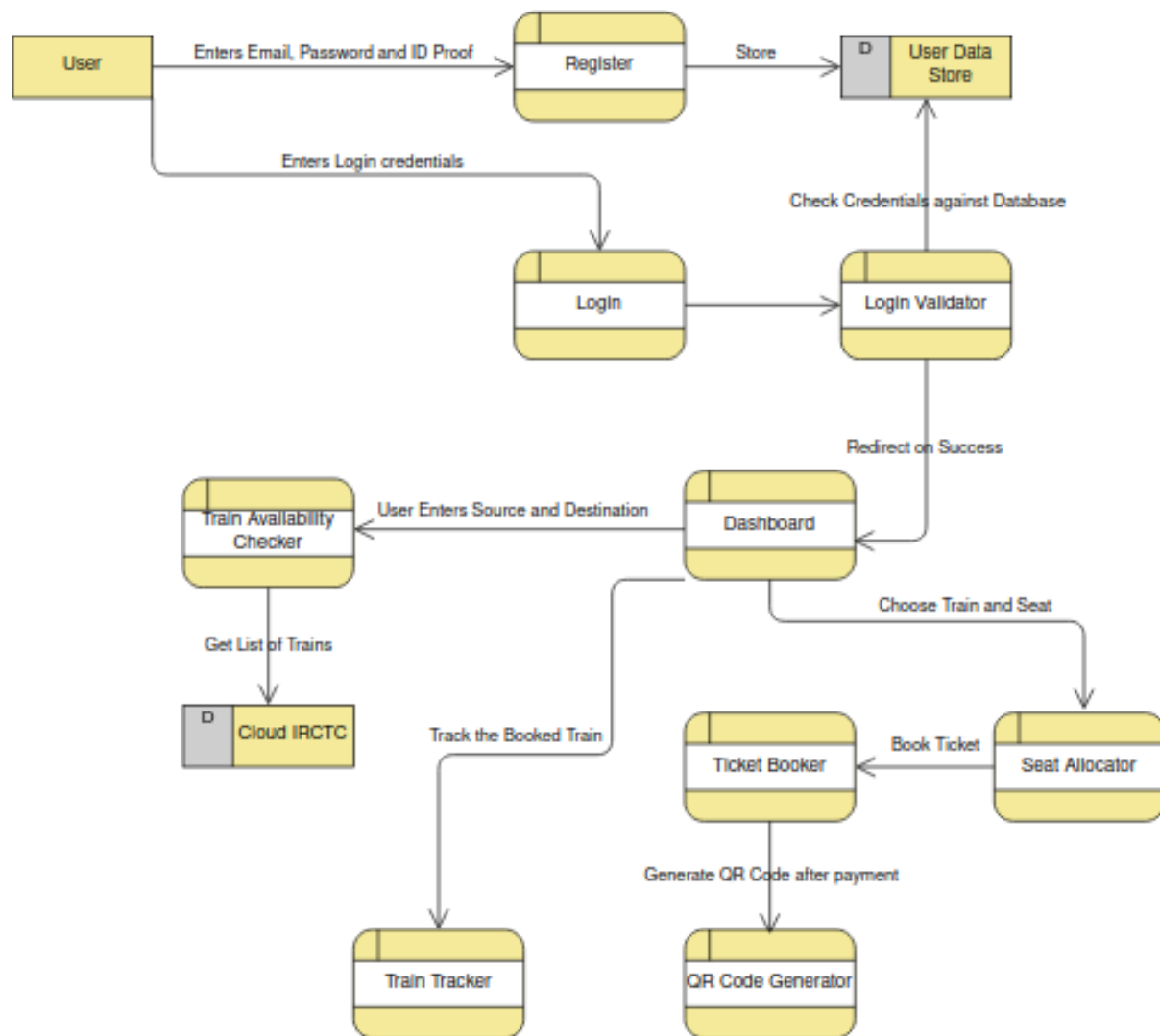## 5.1 DATA FLOW DIAGRAMS

Figure 1: Flow Diagram

In Figure 1:

1. Sending sensor data to IBM Watson
2. Strong date Cloud using Cloudant
3. Sending the stored date from Cloud User Interface created
4. Displaying the interface to the User

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 / Webuser)	UI	USN-1	As a user, I can register for the application by entering my email, password, and confirmingmy password.	I can access my account / dashboard	High	Sprint-1
Customer (Mobile/ Webuser)	Login	USN-2	As a user, I will receive confirmation emailonce I have registered	I can receive confirmation email & click confirm	High	Sprint-1

			for the application			
Customer (Mobile user)	Booking tickets	USN-3	As a user, I can register for the application and enter the details for reserving the ticket.	I can view and modify the details	High	Sprint-2
Customer (Web user)	Booking tickets	USN-4	As a user,I can enter my details to book traintickets	I can book tickets and receive a QR code	High	Sprint-2
Customer (Mobile user)	Dashboard	USN-5	The details of the particular user are displayedalong with previous and current ticket bookinghistory	I can change the information when required	Medium	Sprint-3
Customer Care Executive	Helps users resolve queries and gives them better user experience		Makes sure proper service is provided to all theusers	Has privilege to report queries of users to the respective teams that built a particular service of the application	Medium	Sprint-4
Admin	Administers the working of the application		The data provided by users are monitored by admins.	Can make modifications to data provided by users	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 for the application by entering my email, password, and confirming my password.	5	High	Arun Tiilak Karthe, Bharath Kumar D P
Sprint-1	User Login	USN-2	As a user,I can log into the application by entering email and password.	5	High	Sri Priyan S, Harish J
Sprint -1	Creating databases in IBM Cloud	USN-3	Databases are created to store user and ticket booking details.	5	High	Sri Priyan S, Bharath Kumar D P
Sprint-1	Location tracker simulation using IBM Watson Platform	USN-4	The live location of trains is simulated using location tracker device.	4	Medium	Arun Tiilak Karthe,Harish J
Sprint-2	Checking availability of trains and booking tickets	USN-5	As a user ,I can search for the available trains with the expected data,time of arrival and travel for a given source and destination and book tickets.	5	High	Sri Priyan S,Arun Tiilak Karthe
Sprint-2	QR Code generation for ticket	USN-6	As a user,I can get a QR code after making payment which can be verified by the train ticket examiner	5	High	Bharath Kumar D P,Harish J
Sprint-2	User Interface for QR code	USN-7	As a user,I can get my tickets verified using QR code scanner	5	High	Sri Priyan S,Bharath Kumar D P
Sprint-2	Integration with payment gateways	USN-8	As a user , I can pay the price for the tickets booked using payment gateways	5	High	Arun Tiilak Karthe,Harish J
Sprint-3	Live tracking the trains	USN-9	As a user , I can track the live location for trains after booking tickets using GPS	5	High	Sri Priyan S, Bharath Kumar DP
Sprint-3	Sending push notification to users	USN-10	As a user,I can receive text messages in case there is a delay in the arrival of trains	3	Low	Arun Tiilak Karthe,Harish J
Sprint-4	Testing the application	USN-11	The application is tested to check if it works as desired..	4	High	Arun Tiilak Karthe, Bharath Kumar D P
Sprint-4	Deploying the application	USN-12	The final application is deployed to IBM cloud.	3	Medium	Harish J,Sri Priyan S

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	19	6 Days	24 Oct 2022	29 Oct 2022	19	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	8	6 Days	07 Nov 2022	12 Nov 2022	8	12 Nov 2022
Sprint-4	7	6 Days	14 Nov 2022	19 Nov 2022	7	19 Nov 2022

7 CODING & SOLUTION

7.1 LOCATION TRACKING

```
from wiotp.sdk import device
import time

gpsConfig = {
    'identity' : {
```

```python
        'orgId': 'f336wj',
        'typeId': 'GPS',
        'deviceId': 'GPS123'
    },
    'auth': {
        'token': '12345678'
    }
}

client = device.DeviceClient(gpsConfig)
client.connect()

lat = 13.0827
lon = 80.2707
while lat > 12.5:
    location = { 'name': 'Chennai Express', 'lat': lat, 'lon': lon }
    client.publishEvent(eventId="status", msgFormat="json", data=location,
qos=0)
    lat -= 0.01
    lon -= 0.01
    time.sleep(1)
```


[18]

7.2 Login Flow

7.3 QR Code Generation Flow
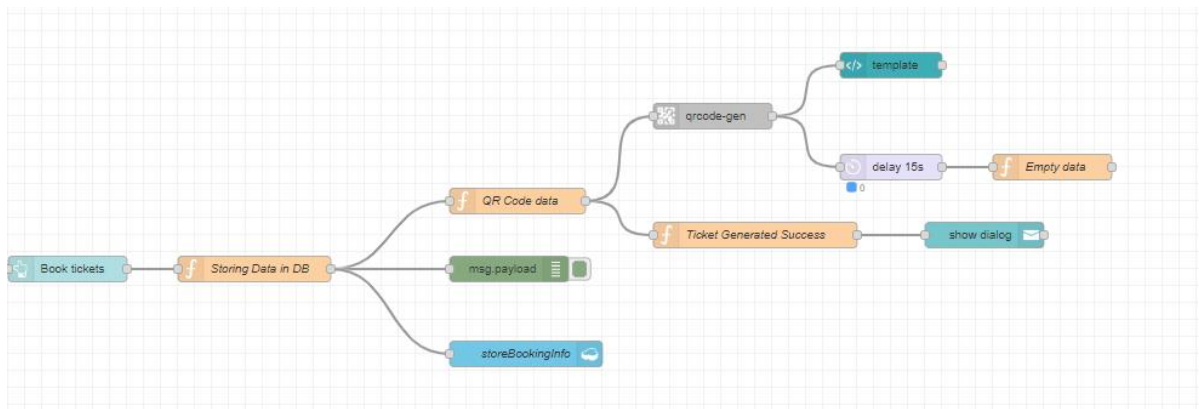
7.4 QR Code Reader

```
import cv2
import time
import pyzbar.pyzbar as pz
from ibmcloudant.cloudant_v1 import CloudantV1
from ibm_cloud_sdk_core.authenticators import BasicAuthenticator

authenticator = BasicAuthenticator ('apikey-v2-
157db41pwa7immzmyhhr9ezh7ll4nql1q2gbcdn9xcnk',
'3620d13725bc37d50ff9e9d9bf5d4b73')
service = CloudantV1(authenticator=authenticator)
service.set_service_url ('https://apikey-v2-
157db41pwa7immzmyhhr9ezh7ll4nql1q2gbcdn9xcnk:3620d13725bc37d50ff9e9d9bf5d4b73@
994dc686-4910-4586-b44f-0b06c6953c31-bluemix.cloudantnosqldb.appdomain.cloud')
```

```
cap = cv2.VideoCapture(0)
font = cv2.FONT_HERSHEY_PLAIN

while True:
    _, frame = cap.read()
    decodedObjects = pz.decode(frame)
    for obj in decodedObjects:
        a=obj.data.decode('UTF-8')
        cv2.putText(frame,"Ticket", (50, 50), font, 2,(255,0, 0), 3)
        try:
            response = service.get_document(db='sp45_db',
doc_id=a).get_result()
            print(response)
            time.sleep (5)
        except Exception as e:
            print ("Not a Valid Ticket")
            time.sleep (5)
    cv2.imshow ("Frame", frame)
    if cv2.waitKey (1) & 0xFF == ord('q'):
        break

cap.release()
cv2.destroyAllWindows()
service.disconnect()
```

7.5 FINAL FLOW
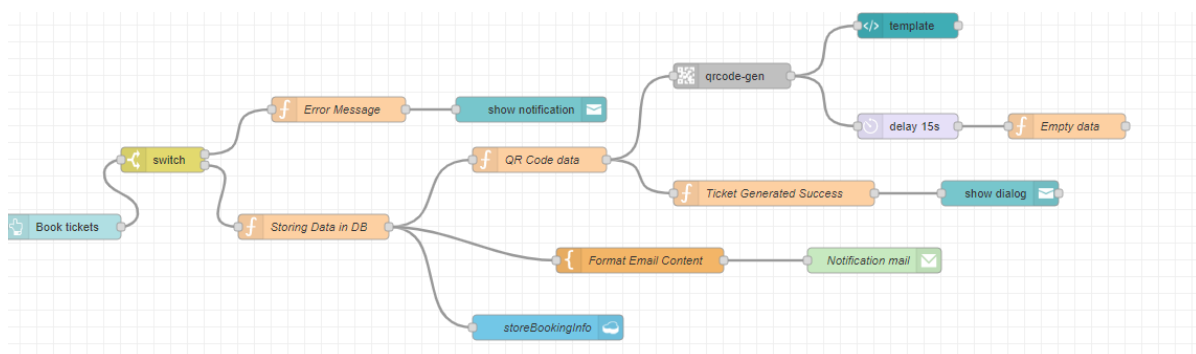
8 TESTING

8.1 TEST CASES

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
TC01	Functional	Scanner	Scanning QR Code	QR Code scanner	Open camera and scan	QR Code	Display details of tickets	Same as expected	Completed	-	N	-	Arun Tiilak Karthe
TC02	Functional	Database	Correct data must be fetched	User already registered	Login to webapp	Email & Password	Correct email-password pair logs in user	Same as expected	Completed	-	N	-	Bharath Kumar D P
TC03	Functional	Database	Sending mail reminders	User booked ticket	Book tickets	Any valid booking	Train details sent to mail	Same as expected	Completed	-	N	-	Harish J
TC04	Exception Reporting	Scanner	Scanning Invalid QR Code	Random QR code generated	Open camera and scan	Random QR Code	Error message	Same as expected	Completed	-	N	-	Sri Priyan S

8.2 USER ACCEPTANCE TESTING

Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	5	3	4	0	12
Duplicate	1	1	0	1	3
External	3	1	1	0	5
Fixed	9	5	5	1	20
Not Reproduced	0	0	0	0	0
Skipped	0	0	0	0	0
Won't Fix	0	0	0	0	0
Totals	9	5	5	1	20

Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested.

Section	Total Cases	Not Tested	Fail	Pass
Functional	3	0	0	3
Exception Reporting	1	0	0	1

9 RESULTS

9.1 PERFORMANCE METRICS

S.No	Project Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score	Justification
				NFT - Risk Assessment					
1	User Registration	New	Low	No Changes	Low	Moderate	>5 to 10%	GREEN	User registration is a one-time event, can use other exisiting account if needed
2	Ticket Booking	New	High	No Changes	Moderate	Severe	>5 to 10%	RED	Ticket booking is a core part of the app
3	QR Code Generation	New	High	No Changes	High	Severe	>5 to 10%	ORANGE	QR generation is crucial
4	QR Code Checking	New	Moderate	No Changes	Low	Severe	>5 to 10%	ORANGE	QR code verification is vital, but can be substituted by other means
5	World Map	New	Low	No Changes	Moderate	Moderate	>5 to 10%	GREEN	World map view is a useful feature, but not a vital feature in the application

S.No	Project Overview	NFT Test approach	Assumptions/Dependencies/Risk	Approvals/SignOff
		NFT - Detailed Test Plan		
1	User Registration	Load Test	Users register only once	Approved
2	Ticket Booking	Performance Test	Users have already registered	Approved
3	QR Code Generation	Performance Test	None	Approved
4	QR Code Checking	Load Test	Clean Camera + internet needed	Approved
5	World Map	Performance Test	None	Approved

S.No	Project Overview	NFT Test approach	NFR - Met	Test Outcome	GO/NO-GO decision	Recommendations	Identified Defects (Detected/Closed/Open)	Approvals/SignOff
				End of Test Report				
	Smart Solution for railways	Load + Performance Testing	Met	Project has met necessary constraints	GO	None	No defects	Approved

10 ADVANTAGES & DISADVANTAGES

Advantages

- Users can track the live location of trains
- QR code generated for each ticket purchase makes it easier to verify purchases
- Push notifications for change in train status allows users to never miss an update

Disadvantages

- Server overhead required to store each QR code
- GPS trackers in trains must be frequently checked to ensure it is in proper condition

11 CONCLUSION

Current infrastructure for booking railway tickets is outdated and not suitable for the high volume of tickets booked per day. This project aims to modernize the

process and provide an easier option for passengers to book tickets. It also proves successful in reducing paper usage by removing the need to carry tickets for verification due to the addition of QR code verification. The usage of fraud tickets can also be solved by this.

12 FUTURE SCOPE

The web app can be updated with a machine learning model that predicts the likelihood of securing a ticket if it is in "Waiting List", based on the previous booking history for the given train. Food preferences can be obtained via the app while booking tickets which can be useful for handling the logistics required to operate food catering services in trains.

13 APPENDIX

GitHub link: [IBM-EPBL/IBM-Project-50562-1660916264: Smart Solutions For Railways (github.com)](github.com)

Demo Link: [IBM-Project-50562-1660916264/FinalDemo.mov at main · IBM-EPBL/IBM-Project-50562-1660916264 (github.com)](github.com)