NALAIYATHIRAN

SMART SOLUTION FOR RAILWAYS USING IOT

BY:-

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1.INTRODUCTION

1.1 PROJECT OVERVIEW

Smart Solutions For Railways is to manage Indian Railways is the largest railway network in Asia and additionally world's second largest network operated underneath a single management.Due to its vast network it is difficult to monitor all the sectors of railways. This paper deals with the problem to locate the exact location of the train and to provide a ticket confirmation through QR code which helps in reducing the usage of paper. GPS module connected with the Ardunio UNO to simulate the process.A mobile application has been developed for the end users to track their exact train location. This is the application of IOT, is a cost effective system. This effective methodology of GPS tracking helps the Users to detect their exact location.

1.2PURPOSE

GPS tracking is the surveillance of location through use of the Global Positioning System (GPS) to track the location of an entity or object remotely. The technology can pinpoint longitude, latitude, ground speed, and course direction of the target.

The GPS is a "constellation" of 24 well-spaced satellites that orbit the Earth and make it possible for people with ground receivers to pinpoint their geographic location. The location accuracy is anywhere from 100 to 10 meters for most equipment. Accuracy can be pinpointed to within one meter with special military-approved equipment. GPS equipment is widely used in science and has now become sufficiently low-cost so that almost anyone can own a GPS and many do in a smartphone, tablet or GPS navigation device.

GPS tracking is invaluable for police, firefighters, military personnel and large courier businesses. Many of these use automatic vehicle locator (AVL) systems. AVL systems generally include a network of vehicles that are each equipped with a mobile radio receiver, a GPS receiver, a GPS modem and a GPS antenna. This network connects with a base radio consisting of a PC computer station as well as a GPS receiver and interface. GPS uses interactive maps rather than static map images on the Web. AVL systems can be used to increase the accountability of field personnel and boost the

efficiency of a company's dispatching procedure through tracking and communication.

Other GPS tracking technologies include GPS guns that law enforcement can fire at a fleeing car, avoiding a dangerous pursuit. In some places, law enforcement representatives also use GPS dust, which consists of GPS trackers so small they might be blown or rubbed on a target's clothing.

GPS devices in smartphones and other mobile devices are often used to track employee location. Privacy advocates warn that the technology can also make it possible for advertisers, government, hackers and cyberstalkers to track users through their mobile devices.

2. LITERATURE SURVEY

2.1 Existing problem

GPS receivers rely on signals from at least four satellites. If they only connect with three, the positioning is not entirely accurate. When obstacles such as walls, buildings, skyscrapers, and trees obstruct a signal, problems can arise.

Geomagnetic storms and other extreme atmospheric conditions can also cause problems. Furthermore, the mapping technology used in conjunction with the GPS may be inaccurate or out of date, resulting in navigational errors.

Relying solely on GPS can be problematic if there is a signal failure or you are using a battery-powered device that runs out of power (GPS devices are almost always power-hungry). Unless you have a backup plan, such as hard copy maps, you could easily get lost and have no idea which way to go.

Another issue is that the position can be significantly off at times, especially when the number of satellites is limited. Satellites use atomic clocks, which are very precise, but there are sometimes discrepancies and thus time measurement errors. The satellites must preserve their predefined orbital positions, but gravitational pulls (from the earth, moon, and sun) do occur.

GPS devices are, by definition, distracting. In theory, they will relay audio instructions to you, and all you have to do is glance over at the map from time to time. In practice, however, you may end up fiddling with your smartphone or other devices while driving, attempting to change the destination, enter data, or change other settings. It's a recipe for disaster.

2.2 References

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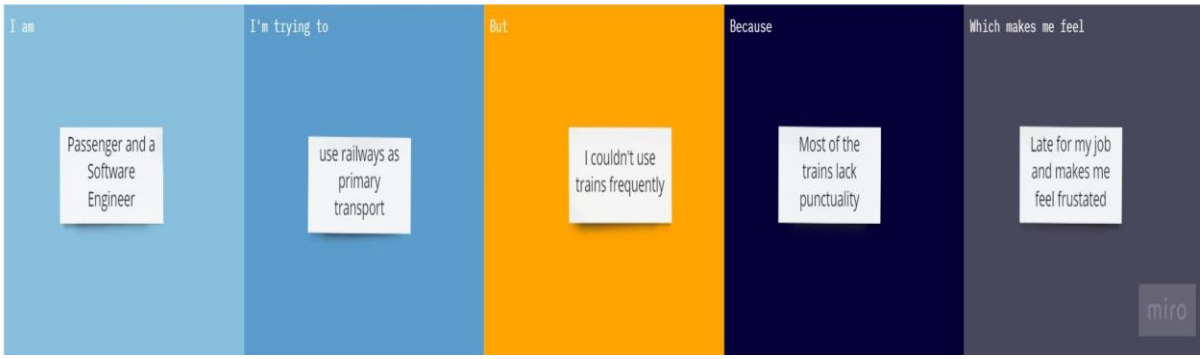
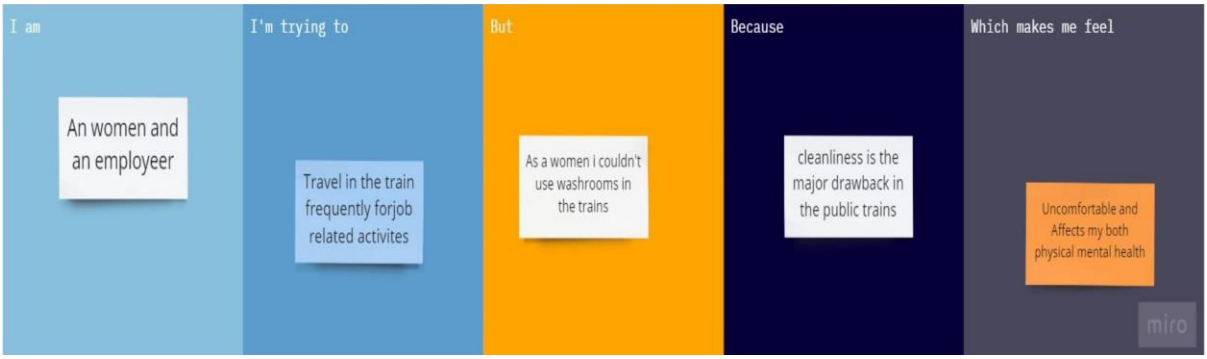
2.3 Problem Statement Definition

Create a problem statement to understand your customer's point of view. The Customer Problem Statement template helps you focus on what matters to create experiences people will love.

A well-articulated customer problem statement allows you and your team to find the ideal solution for the challenges your customers face. Throughout the process, you'll also be able to empathize with your customers, which helps you better understand how they perceive your product or service.



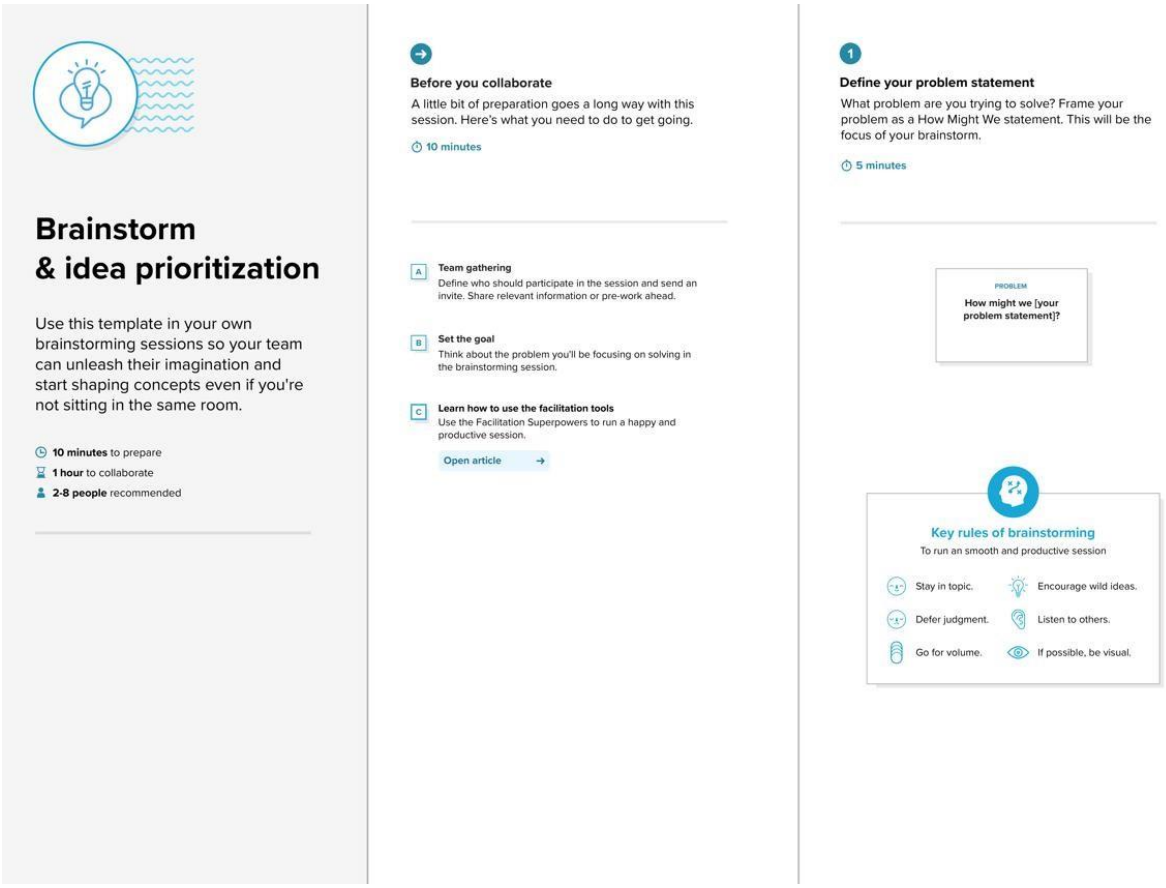


3. IDEATION & PROPOSED SOLUTION

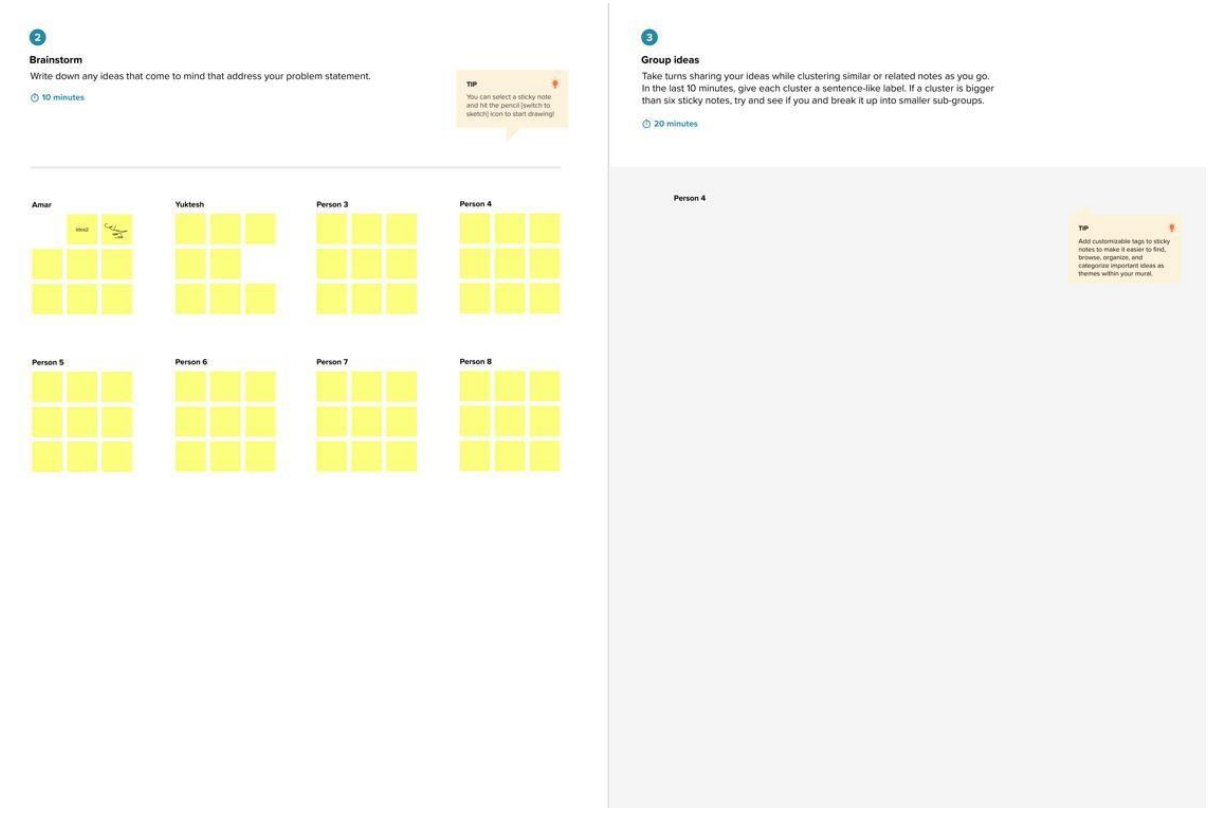
3.1 Empathy Map Canvas

3.2 Ideation & Brainstorming

Step-1



Step-2



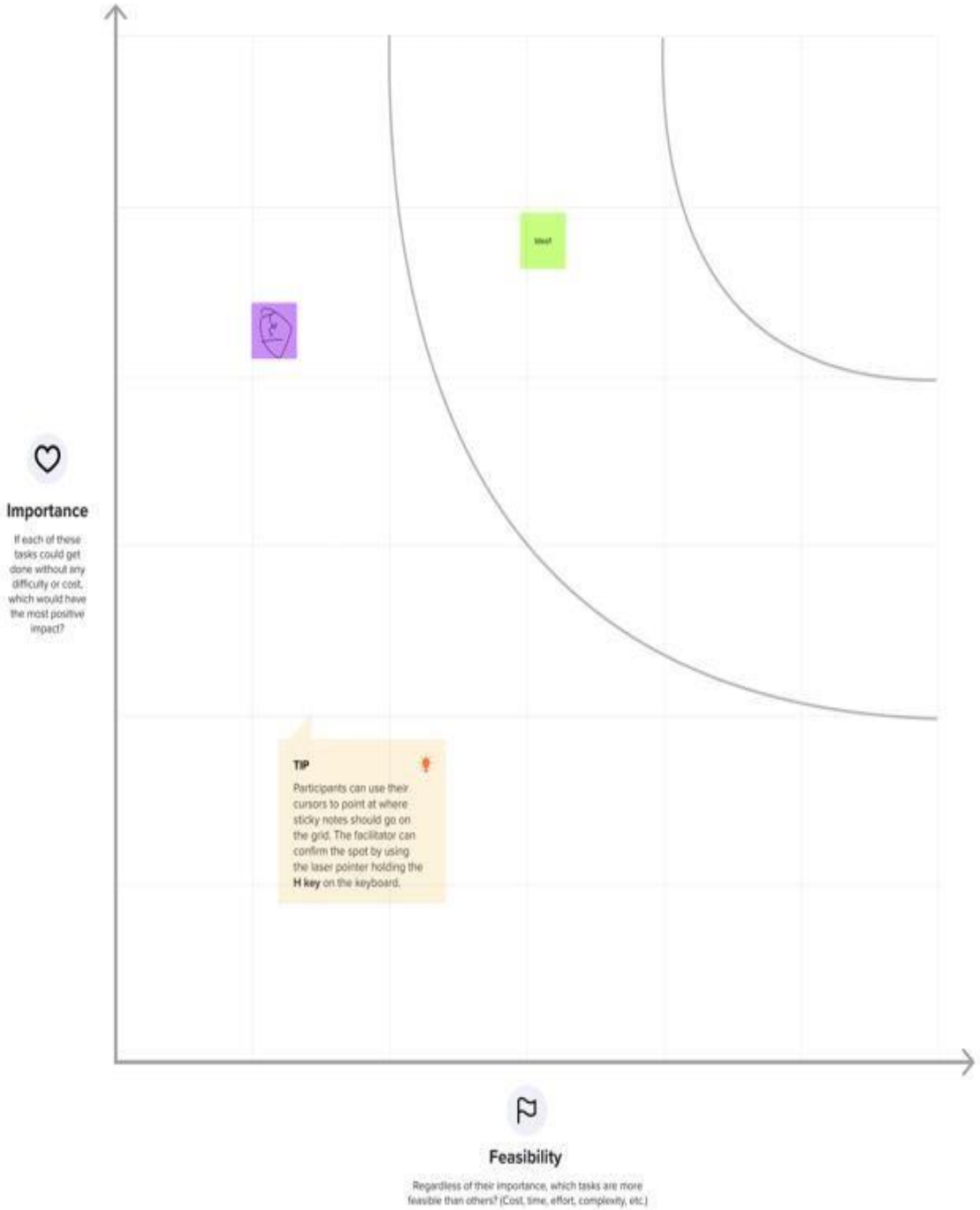
Step-3

4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes



Step-4

JAYAVARSHINI K.P.

weather station

train delay monitoring

predicting the railway accident on tracks

nearby local places for tourist to explore

passenger wifi acess and security

suicide gate monitoring

sensors would detect when a person climbs over the fencing or jumps into the water below, alerting the guards stationed

asset tracking

cell towers

ticketing machine

Automatic Ticket Vending Machine is use to reduce passengers queuing up at the Ticket counters at the Railway Stations. ATVMs are touch screen based ticketing operated using Smart cards.

kavitha.P

B-Scan ultrasonic rail flow detection and track inspection with automated high speed test trains

reliable onboard wifi so the passenger can stay connected through out of journey

implementing safety sensors across all part of a railway can provide a safer rail experience for everyone

Making it as primary means of transport by constructing more boarding points rather than station

increased surveillance of personnel with both interior and exterior locomotive video to improve monitoring

using cameras in the station and deep learning AI can measure and analyze passenger flow to avoid loss of revenue, passenger dissatisfication,inffficient operations

track laying machine for mechanism of construction

implementing vibrator sensor in the train so that we can avoid vibrations

Prabhatharan.D(mentor)

By using Edge computing to find obstacles in the railway tracks

Waters utilized can be saved and recycled

focus on delivering an enhanced frictionless and convenient experience that keeps passenger coming back for future travel

implementing edge computing AI and cloud based technology operations can eliminate queue lines at ticket

Durga devi.S

mechatronic switches

interactive train window

automatic guide service

motion of train without tracks

the internet of train (humidity and PIR sensor)

digital wayfinding

ticket conformation through barcode

NfC Technology to speed up ticketing and payment

Even after the aadvancements and developments still humans clean the tracks which is filled with human waste and others.

Mini health clinic can be setup incase for emergency treatment

YOKESHWARI.S

Replacement of humans in cleaning by machines

Dispensaries in trains

Facility to order food items while booking tickets

Ability to stop the train at the moment instantly

Replacement of electricity by Magnet for movement

Controlling vibration caused in trains by using vibration sensor

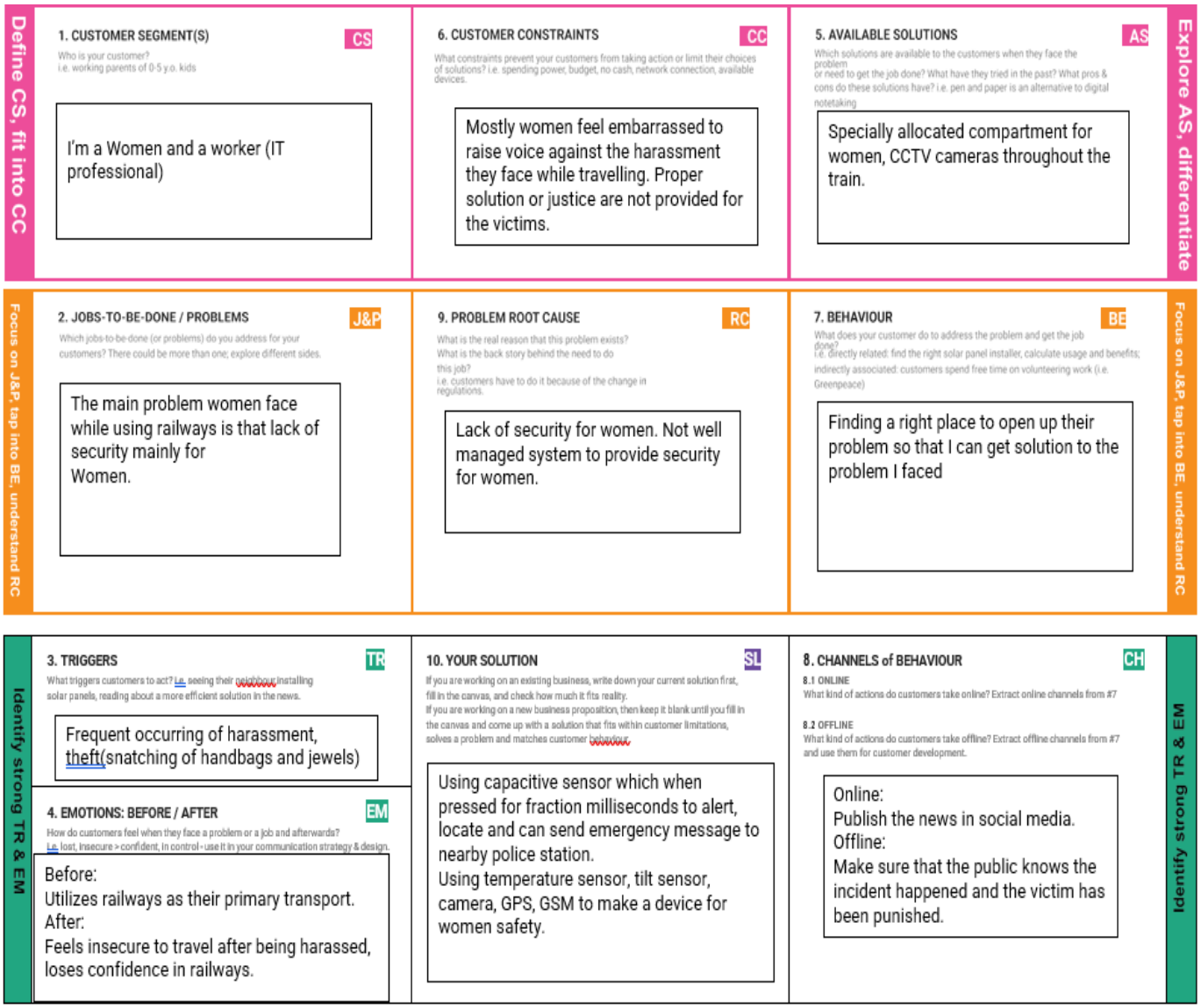
Producing electricity by increasing the speed gauge above 125Km

Fixing solar panels on the roof of train along with pantograph

3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	A working person who is dependent on railway mode of transportation cant reach his/her destination place on time due to train delay(train lacks punctuality)
2.	Idea / Solution description	By building a 'layer of intelligence' into the signaling company's real time monitoring system.The solution was able to forecast delays an hour in advance and helped controllers as well as passengers to decide best alternatives to reduce delays.
3.	Novelty / Uniqueness	Enhanced customer experience ,vehicle tracking system.IOT is used along with AI which provides enhanced features in finding out delays.
4.	Social Impact / Customer Satisfaction	By predicting the delays ,it helps the passengers to plan accordingly to their work or trip which avoids the last minute stress
5.	Business Model (Revenue Model)	By using this solution, it makes passengers to avoid delays which increases more number of people to use railway mode of transportation which increases the revenue of railways
6.	Scalability of the Solution	Using IoT in railways, increased the use of trains among people due to its convenient usage. According to Allied Market Research reported that the market was valued at $135 billion USD in 2016 and was expected to grow to $328 billion USD by 2023.

3.4 Problem Solution fit



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Authentication (User Registration)	Registration through Form Registration through gmail Registration through specific apps
FR-2	Authorization level (User Confirmation)	Confirmation via Email Confirmation via OTP
FR-3	External interfaces	External interface are between contracts under the main engineer responsibilities and third parties

		some external interface are cellphone,terminal,pc's etc
FR-4	Transaction process	Can book tickets using credit card Tickets booking through net banking Tickets booking through online transaction such as gpay,phone pay,applepay and so on
FR-5	Reporting	Reporting data contributes to enhanced the transparency to extent work regarding saftey certification
FR-6	Business rules	Get full refund for short terminated routes

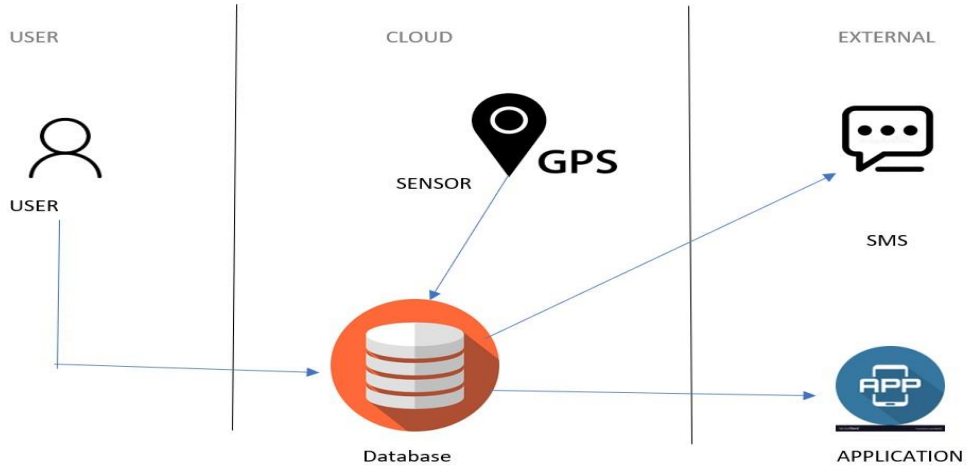
4.2 Non-Functional requirements

FR No.	**Non-Functional Requirement**	**Description**
NFR-1	**Usability**	Can easily book the train tickets when ever we want Users can easily track the train at any time
NFR-2	**Security**	Passenger details are encrypted so there low chance of get hacked The personal detail will not leak
NFR-3	**Reliability**	Features are very simple so that anyone can easily book the tickets
NFR-4	**Performance**	Can support nearly 10000 users at a time
NFR-5	**Availability**	Seat availability for the passenger E-Catering are available in side the train WIFI availibility to get connected with the people throughout the travel
NFR-6	**Scalability**	Reduced renewal and life cycle cost Automatic route finding

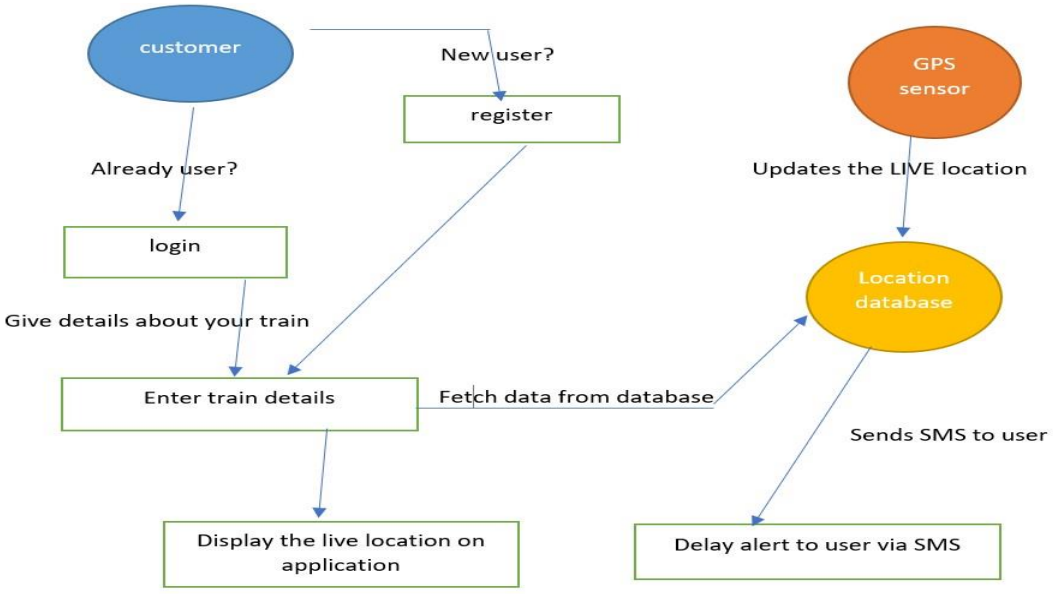
5. PROJECT DESIGN:

5.1 Data Flow Diagram:

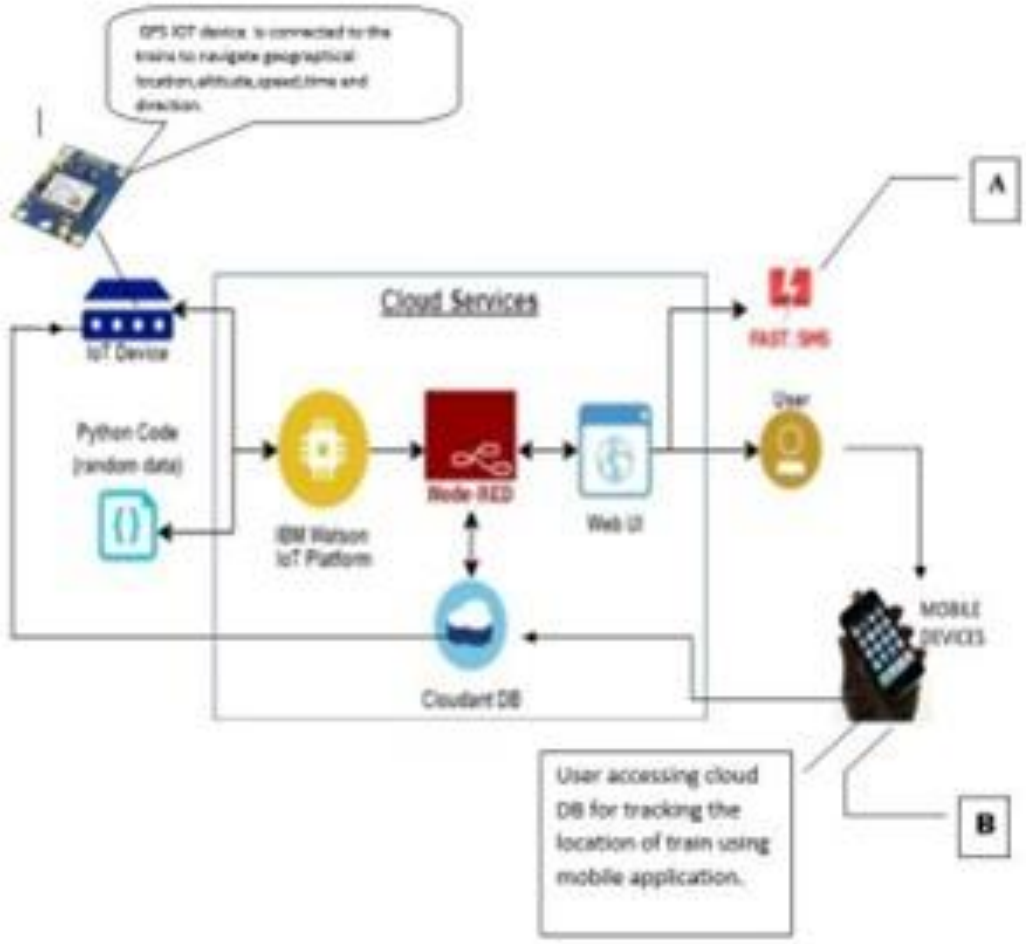
Level-0



Level-1



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)	User Registration	USER-1	As a passenger I can book tickets through both online and offline mode.	I can access my account using my given ticket ID	High	Sprint-0
Customer (Mobile user)	User confirmation	USER-2	As a Passenger, I will receive confirmation email or OTP once I have registered for the application.	I can receive confirmation email & click confirm	High	Sprint-1
Customer (Mobile user)	Transaction process	USER-3	For transaction, I can use credit cards, net banking and cash.	I can receive the invoice receipt	Low	Sprint-2
Customer (Mobile user)	Business rules	USER-4	As a passenger, I can get an SMS when the train gets delay.	I can receive SMS when train gets delay	High	Sprint-1
Customer (Web user)	User Registration	USER-1	As a passenger I can book tickets through both online modes.	Can easily book train tickets whenever we want	High	Sprint-0
Customer (Web user)	Authentication	USER-2	Passenger details are encrypted so there is low chance to get hacked.	The personal detail will not leak	High	Sprint-1
Customer (Web user)	Accomplishment	USER-3	Features are so simple and effective.	Can support nearly 1000 users at a time	Low	Sprint-2

Customer Care Executive	Reporting	USER-1	Reporting data contribute to enhanced transparency to extent work regarding safety	Dealing with customer, and helping them to clear their queries.	Low	Sprint-0
Customer Care Executive	Problem solving skill	USER-2	Interacting with customers to ensure they have a desirable experience and customer satisfaction.	Handling customer with their complaints	High	Sprint-1
Administrator	Chief executive	USER-1	Create user or organization and provide access to user to login to IOT platform with user management administrator console	Responsible for all damage and maintains the entire system	High	Sprint-0

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	Simulationcreation	USN-1	The first and foremost task is connecting sensors and Arudino using python code	2	High	Yokeshwari. S Durga devi. S Jayavarshini. K. PKavitha. P
Sprint-2	Software	USN-2	Creating device in the IBM Watson IOT platform, workflow for IOT scenarios using Node-red in connection with IBM cloud.	1	High	Yokeshwari. S Durga devi. S Jayavarshini. K. P Kavitha. P
Sprint-3	MIT App Inventor	USN-3	Develop an application for	2	Low	Yokeshwari. S Durga devi. S

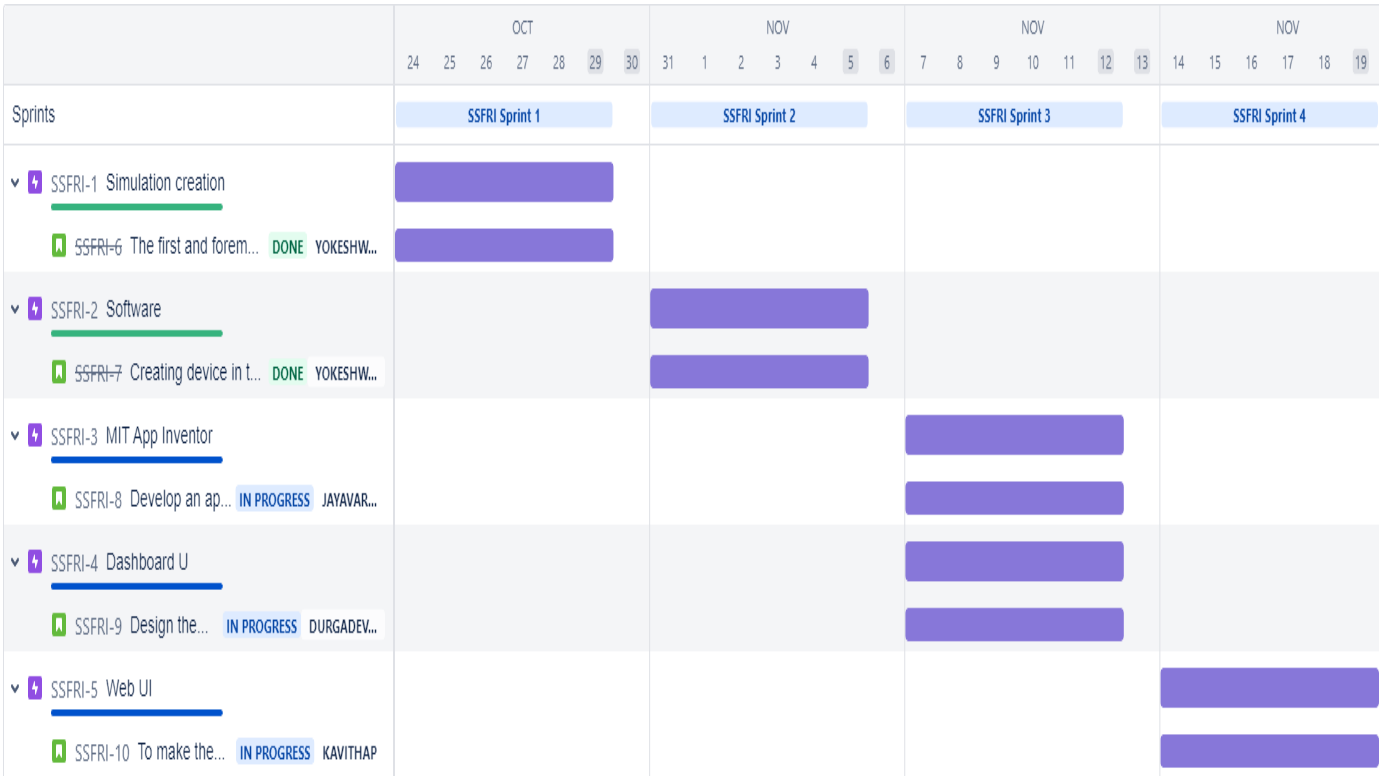
			railways usingIOT project using MIT App Inventor in theIBM cloud.			Jayavarshini. K. P Kavitha. P
Sprint-3	Dashboard	USN-3	Design the modules and test Apps	2	Medium	Yokeshwari. S Durga devi. S Jayavarshini. K. PKavitha. P
Sprint-4	Web UI	USN-4	To make the user to interact with software	1	High	Yokeshwari. S Durga devi. S Jayavarshini. K. PKavitha. P

6.2 Sprint Delivery Schedule

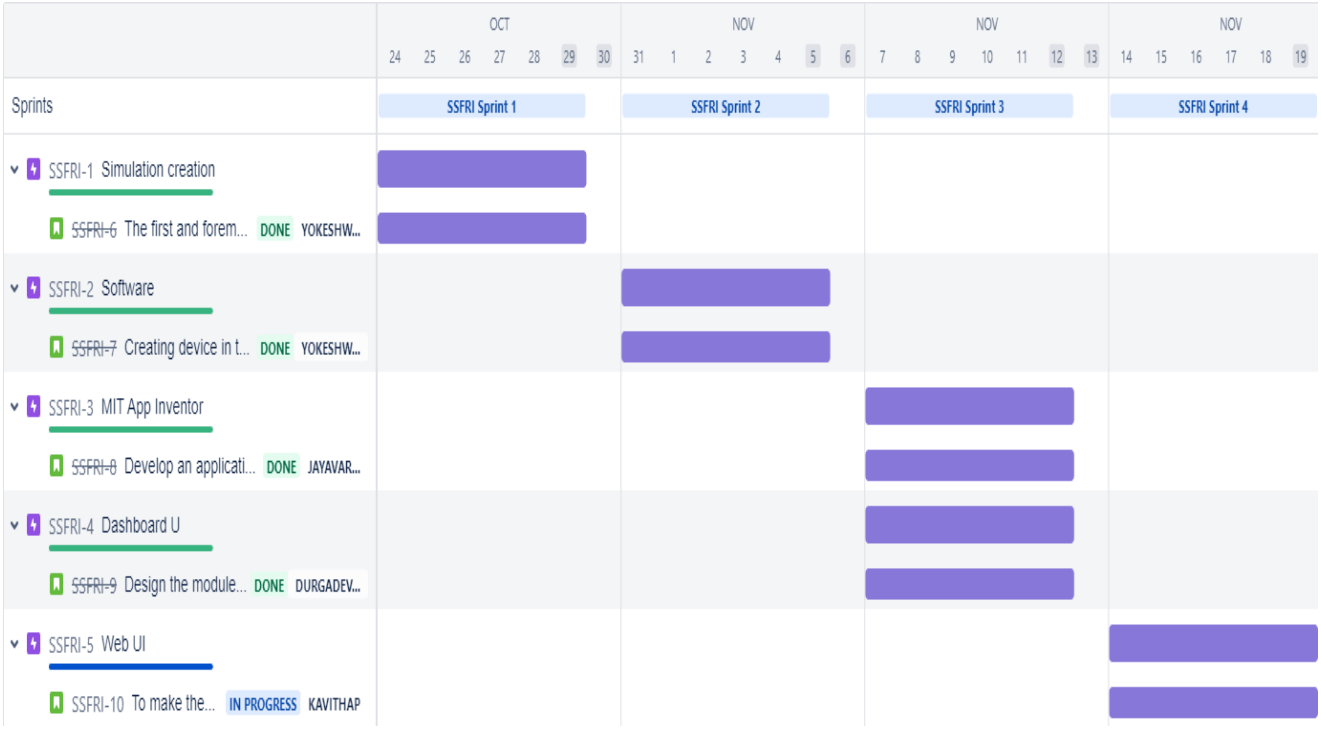
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned EndDate)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

6.3 Reports from JIRA

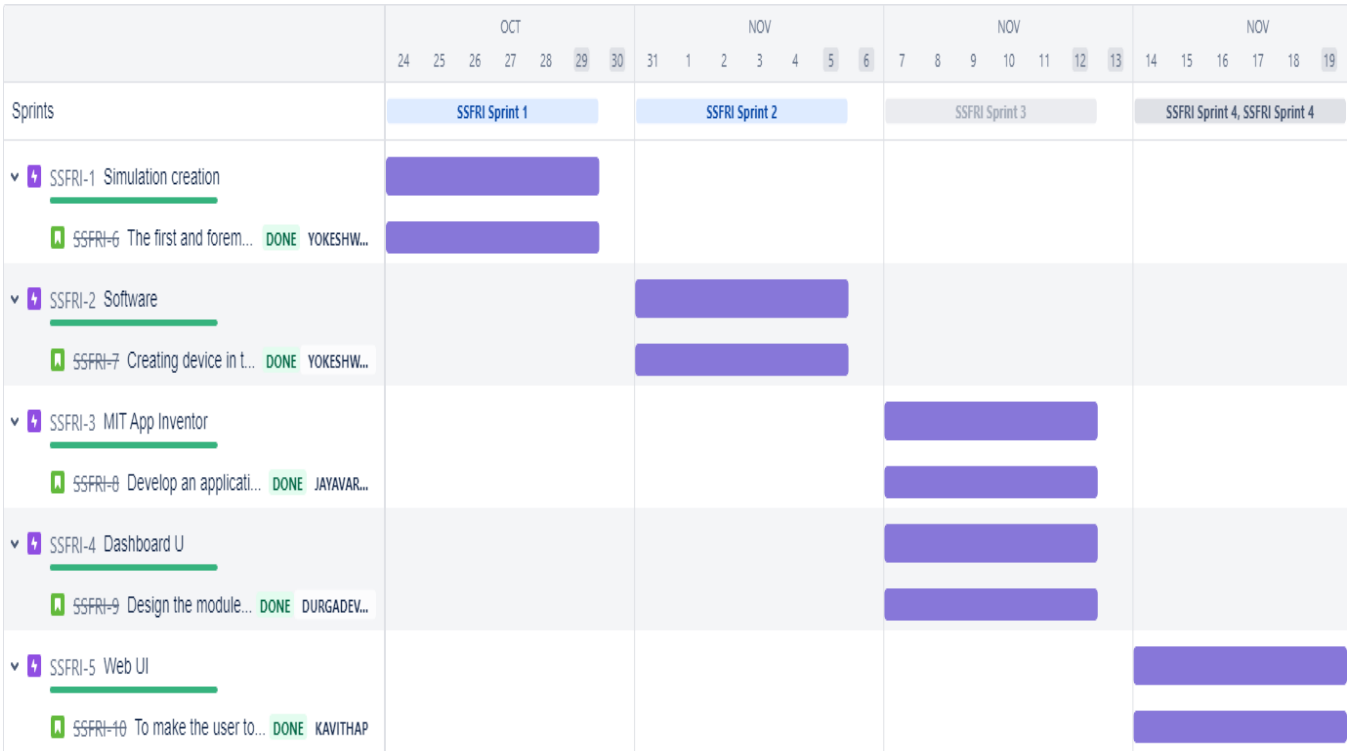
Roadmap of Sprint-1 and sprint-2



Roadmap of Sprint-3



Roadmap of Sprint-4



7.CODING & SOLUTIONING (Explain the features added in the project along with code)

7.1 Feature 1

Our project is user friendly which is easy to access. It also generates tickets through QRcode in a mobilized way whuch reduces man work , also reduces the usage of paper

Code

Pythonc code:-

1.GPS code.py

```
import time
import sys
```

```
import ibmiotf.application
import ibmiotf.device
import random
import requests
import json

#Provide your IBM Watson Device Credentials
organization = "vptt54"
deviceType = "GPS"        #Credentials of Watson IoT sensor simulator
deviceId = "1234"
authMethod = "token"
authToken = "12345678"



# Initialize the device client.
L=0

try:
deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod, "auth-token": authToken}
deviceCli = ibmiotf.device.Client(deviceOptions)
#.....


except Exception as e:
print("Caught exception connecting device: %s" % str(e))
sys.exit()

# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type "greeting" 10 times
deviceCli.connect()
```

```
while True:
    overpass_url = "http://overpass-api.de/api/interpreter"
    overpass_query = """
    [out:json];area[name="India"];(node[place="village"](area););out;
    """

    response = requests.get(
    overpass_url,
    params={'data': overpass_query}
    )

    coords = []
    if response.status_code == 200:
        data = response.json()
        places = data.get('elements', [])
        for place in places:
            coords.append((place['lat'], place['lon']))
        print ("Got %s village coordinates!" % len(coords))
        print (coords[0])
    else:
        print("Error")

    i = random.randint(1,100)
    L = coords[i]
    #Send random gprs data to node-red to IBM Watson
    data = {"d":{ 'Latitude' : L[0], 'Longitude' : L[1]}}
    #print data
    def myOnPublishCallback():
        print("Published gprs location = ", L, "to IBM Watson")
```

```
    success = deviceCli.publishEvent("Data", "json", data, qos=0,
on_publish=myOnPublishCallback)
    time.sleep(12)
    if not success:
        print("Not connected to IoTF")
    time.sleep(1)


deviceCli.disconnect()
```

8. TESTING

8.1 Test Cases

Simulation process
Client Application
Security
Exception Reporting
Final Report Output

8.2 User Acceptance Testing

				Date	11 Nov 22								
				Team ID	PNT2022TMID39421								
				Project Name	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	Commnets	TC for Automation(Y/N)	BUG ID	Executed By
1	Functional	Registration	Registration through the form by Filling in my details		1.Click on register 2.Fill the registration form 3.click Register		Registration form to be filled is to be displayed	Working as expected	Pass				Yokeshwari. S
2	UI	Generating OTP	Generating the otp for further process		1.Generating of OTP number		user can register through phone numbers, Gmail, Facebook or other social sites and to get oto number	Working as expected	pass				Yokeshwari. S
3	Functional	OTP verification	Verify user otp using mail		1.Enter gmail id and enter password 2.click submit	Username: abc@gmail.com password: Testing123	OTP verifed is to be displayed	Working as expected	pass				Jayavarshini. K.P
4	Functional	Login page	Verify user is able to log into application with InValid credentials		1.Enter into log in page 2.Click on My Account dropdown button 3.Enter InValid username/email in Email text box 4.Enter valid password in password text box 5.Click on login button	Username: abc@gmail password: Testing123	Application should show 'Incorrect email or password ' validation message.	Working as expected	pass				s
5	Functional	Display Train details	The user can view about the available train details		1.As a user, I can enter the start and destination to get the list of trains available connecting the above	Username: abc@gmail.com password: Testing123678686786876876	A user can view about the available trains to enter start and destination details	Working as expected	fail				Yokeshwari. S

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	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2

Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

Test Case Analysis

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

Section	Total Cases	Not Tested	Fail	Pass
Simulation process	7	0	0	7
Client Application	51	0	3	48
Security	2	0	0	2
Exception Reporting	3	0	0	3
Final Report Output	4	0	0	4

9 RESULTS

9.1 Performance Metrics

10. ADVANTAGES & DISADVANTAGES

Advantages:

- you always have it with you
- you can have live maps with traffic
- you can constantly update any downloaded maps
- screen resolution
- search built in
- battery life
- size (small)
- specialist maps for marine and wilderness
- . Free and Independent Operation
- Global Accessibility
- Commercial and Scientific Applications
- Civilian and Personal Applications

Disadvantages

- robustness
- accuracy
- sensitivity (ability to detect the satellites)
- Battery life
- Dependency on one device in safety situations (eg hiking)
- size (big)
- specialist maps for marine and wilderness

11. CONCLUSION

In today's competitive world everyone runs in a race and its most important to reach ones destination on time. There occurs many misfortunes and delays during the train travel. Our project helps the customer or the end user to detect the live location of train using the GPS. This helps us to prevent any further delays in reaching their correct destination at a correct time.

Also our project aims at saving the over usage of resources like paper. We have developed a train ticket confirmation through QRcode generation which is sent to the passengers mobile phone directly. By this method we can

save over utilization of papers. It also reduces man power and helps the ticket checker to easy confirm the passengers identity.

12. FUTURE SCOPE

Global Positioning System (GPS) is much more than just the means of finding a way while commuting. It fulfills a much higher purpose than finding the fastest route. They help you to monitor crucial parameters like speed, trip distance, geo-fencing, real-time tracking among others.

GPS trackers have paved the way for both automobiles like cars, trucks, buses as well as personal safety devices like GPS tracking smartwatches. They are easily trackable via smartphone or laptop keeping you tension-free.

Trackers are small with technological advancement, tend to grow and improve. The future of GPS tracking looks extremely promising and we can expect some interesting advancement in this area. Let's look at what the future holds for GPS monitoring systems.

Compact Size and Longer Life Span– Compact GPS devices are smaller than a cell phone but the experts predict that continuous development may shrink the sizes of these devices further.

The size of the tracker depends on the battery, while a thumbnail-sized receiver can be improved, it needs to be big enough to accommodate the battery. As the battery technology unfolds, in the future, we may be able to see GPS trackers getting smaller in size.

These days, the best trackers can go up to 30 days without a recharge but to go longer, extended battery packs may be needed which provide up to 6 months of uninterrupted usage.

Affordability– GPS trackers are no longer a luxury reserved for big organizations and government agencies. The low price points have brought it within the reach of small companies and even individuals. GPS vehicle tracking is a must for every business and the raised productivity and efficiency make it a value for money.

They are immensely useful for both the professional and personal front. As per their requirements, different sections of people can be catered through the affordable price range. The devices are getting compact yet powerful. Hence, this is the best time to invest in GPS tracking solutions.

Extensive Usage– Past few years have seen a considerable rise in businesses turning to GPS technology, as an effective way to manage their transports, employees, and assets. GPS fleet management systems allow enterprises to access driver's performance, vehicle maintenance to providing other necessary inputs like live vehicle tracking.

As the crime rate increases with each passing day, GPS trackers give a sigh of relief for parents. Trackers ensure the safety of your loved ones- be it children or elderly family members. Parents rely on these trackers to keep a watch and control their inexperienced young teenagers' reckless driving.

13. APPENDIX

Source Code

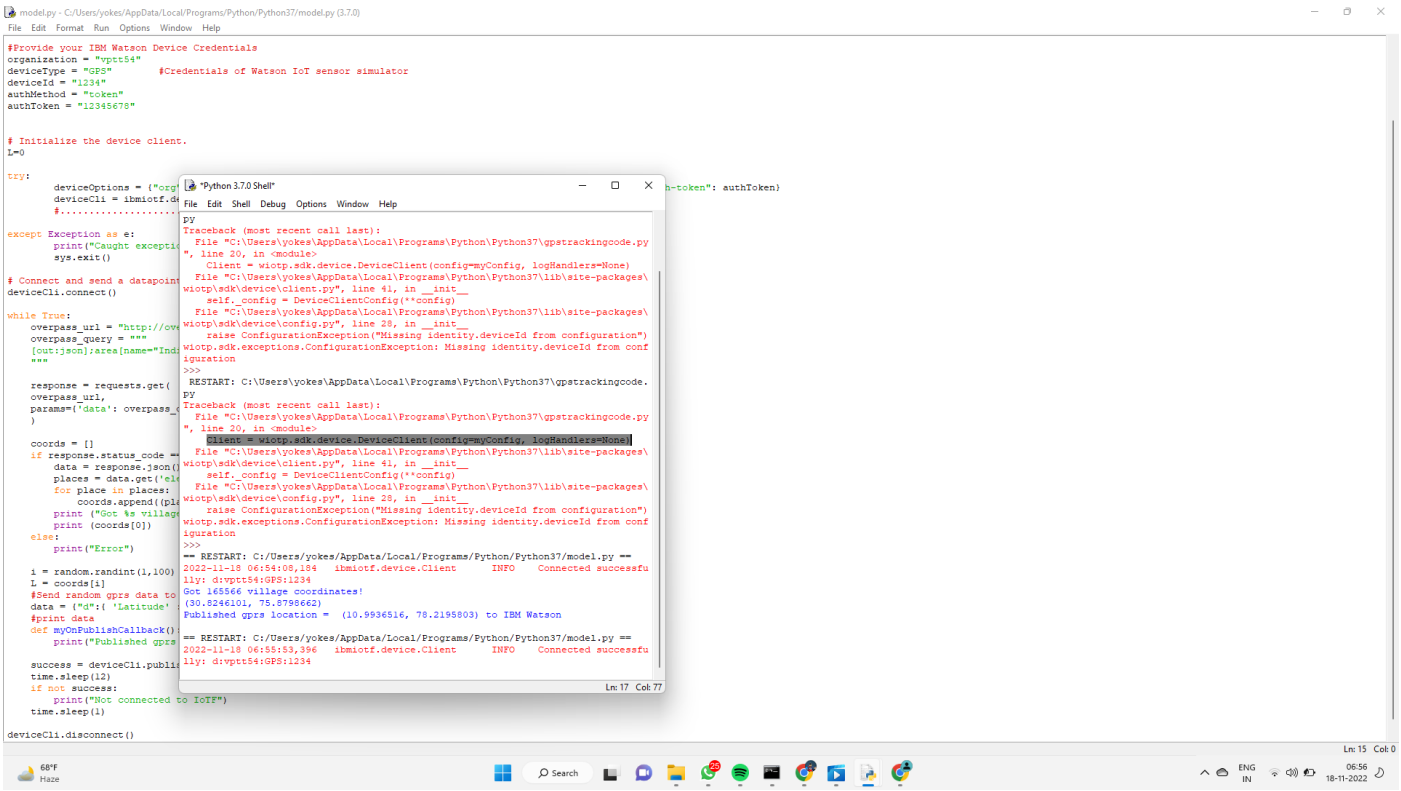
1.Python code for GPS tracking

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random
import requests
import json

#Provide your IBM Watson Device Credentials
organization = "vptt54"
deviceType = "GPS"        #Credentials of Watson IoT sensor simulator
deviceId = "1234"
authMethod = "token"
authToken = "12345678"
```

```
# Initialize the device client.
L=0

try:
        deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-
method": authMethod, "auth-token": authToken}
        deviceCli = ibmiotf.device.Client(deviceOptions)
        #.....................................

except Exception as e:
        print("Caught exception connecting device: %s" % str(e))
        sys.exit()

# Connect and send a datapoint "hello" with value "world" into the cloud as an event
of type "greeting" 10 times
deviceCli.connect()

while True:
    overpass_url = "http://overpass-api.de/api/interpreter"
    overpass_query = """
    [out:json];area[name="India"];(node[place="village"](area););out;
    """

    response = requests.get(
    overpass_url,
    params={'data': overpass_query}
    )

    coords = []
    if response.status_code == 200:
        data = response.json()
        places = data.get('elements', [])
        for place in places:
            coords.append((place['lat'], place['lon']))
        print ("Got %s village coordinates!" % len(coords))
        print (coords[0])
    else:
        print("Error")

    i = random.randint(1,100)
    L = coords[i]
    #Send random gprs data to node-red to IBM Watson
    data = {"d":{ 'Latitude' : L[0], 'Longitude' : L[1]}}
    #print data
    def myOnPublishCallback():
        print("Published gprs location = ", L, "to IBM Watson")
```

```
    success = deviceCli.publishEvent("Data", "json", data, qos=0,
on_publish=myOnPublishCallback)
    time.sleep(12)
    if not success:
        print("Not connected to IoTF")
    time.sleep(1)

deviceCli.disconnect()
```

Output:-



GitHub & Project Demo Link

https://github.com/IBM-EPBL/IBM-Project-3674-1658588435