LAB REPORT

Submitted by

Arnav Aggarwal(RA2111032010002)

Under the Guidance of

Dr. Gouthaman. P

Assistant Professor, Department of Networking and Communications

In partial satisfaction of the requirements for the degree of

BACHELOR OF TECHNOLOGY
in
COMPUTER SCIENCE AND ENGINEERING

with specialization in Internet of Things

SCHOOL OF COMPUTING

COLLEGE OF ENGINEERING AND TECHNOLOGY
SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
KATTANKULATHUR - 603203

MAY 2023

COLLEGE OF ENGINEERING & TECHNOLOGY SRM INSTITUTE OF SCIENCE & TECHNOLOGY
S.R.M. NAGAR, KATTANKULATHUR – 603 203
Chengalpattu District

BONAFIDE CERTIFICATE

Register No. RA2111032010002 Certified to be the bonafide work done by Arnav Aggarwal of II Year/IV Sem B. Tech Degree Course in the **Practical Course – 18CSC206J - Software Engineering and Project Management** in **SRM INSTITUTE OF SCIENCE AND TECHNOLOGY,** Kattankulathur during the academic year 2022 – 2023.

SIGNATURE

Faculty In-Charge
Dr. Gouthaman. P
Assistant Professor
Department of Networking and Communications
SRM Institute of Science and Technology

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HEAD OF THE DEPARTMENT
Dr. Annapurani Panaiyappan. K
Professor and Head,
Department of Networking and Communications
SRM Institute of Science and Technology

ABSTRACT

The Live Tracking System for Delhi Metro Rail Corporation (DMRC) using IoT is a proposed project that aims to provide real-time location tracking of DMRC trains to passengers and authorities. The project utilizes IoT devices and wireless communication technologies to collect and transmit data about the current location of the train.

The system consists of GPS sensors, microcontrollers, and wireless communication modules installed on each train. The GPS sensors collect the current location of the train, which is then processed by the microcontroller to determine the train's speed and direction. The wireless communication module transmits this data to a central server, which processes the data and presents it to passengers and authorities in real-time.

The proposed system will have a user-friendly interface accessible through a mobile application, web portal or kiosk. Passengers will be able to view real-time information about the train's location, its estimated time of arrival and departure, and any delays or disruptions on the route. The system will also provide DMRC authorities with valuable insights into train operations, enabling them to improve service quality and enhance safety measures.

The project aims to improve the commuting experience for passengers and optimize train operations for DMRC by providing accurate and up-to-date information about train movements. The Live Tracking System for DMRC Metro using IoT is a step towards a smarter and more connected transportation system, enabling efficient and seamless mobility for all.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

NO	ABBREVIATION	WORD
1	DMRC	DELHI METRO RAIL CORPORATION
2	IOT	INTERNET OF THINGS
3	GPS	GLOBAL POSITIONING SYSTEM
4	MQTT	MESSAGE QUEUING TELEMETRY TRANSPORT
5	HTTP	HYPER TEXT TRANSFER PROTOCOL
6	SWOT	STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS
7	RMMM	RISK MITIGATION, MONITORING AND MANAGEMENT
8	DFD	DATA FLOW DIAGRAM
9	FTC	FUNCTIONAL TEST CASE
10	NFTC	NON-FUNCTIONAL TEST CASE

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SRM IST, Kattankulathur – 603 203

Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	1
Title of Experiment	To Identify the Software Project, Create Business Case, Arrive at a Problem Statement
Name of the candidate	Arnav Aggarwal
Team Members	Rohit Kumar, Navdeep Singh Jakhar
Register Number	RA2111032010002
Date of Experiment	20.01.2023

Mark Split Up

S.No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	5
	Total	**10**	10

Staff Signature with date

Aim

To frame a project team, analyze and identify a Software project, create a business case,, and arrive at a Problem Statement for the Live Tracking System for DMRC Metro.

Team Members:

S. No	Register No	Name	Role
1	RA2111032010002	Arnav Aggarwal	Lead/Rep
2	RA2111032010009	Ronit Kumar	Member
3	RA2111032010030	Navdeep Singh Jakhar	Member

Project Title: Live Tracking System for DMRC Metro

Project Description-

In day-to-day life, everyone is in a hurry to reach their destination. So, consequently, many of us have to wait for buses and the metro, often unaware of the whereabouts of the vehicle. To overcome this problem, an efficient and simple system is proposed in the paper to track the real-time location of the metro. Vehicle tracking systems are a very safe, reliable, and well-established technology in today's era.
The proposed system has an advantage; nowadays, location services are easily available in mobile phones using Global Positioning System (GPS). The system consists of an IOT system placed in Metros hosting its data over the cloud. The server database is mainly responsible for providing and updating the metro's exact location to the client application. This will provide users with the speed, arrival time and location of the metro in real time.

ONE PAGE BUSINESS CASE TEMPLATE

DATE	20.01.2023
SUBMITTED BY	Arnav Aggarwal
TITLE / ROLE	Live Tracking System for DMRC Metro

LOG

THE PROJECT

In bullet points, describe the problem this project aims to solve or the opportunity it aims to develop.

- This project aims to create a Live Tracking System for the DMRC Metro in and across the city.
- It enables passengers to know when and where exactly the respective metro lines are heading and also what would be the final destination of the metro so that they can plan their journey in a more efficient manner.
- It also helps the user to identify metro locations in real time, detect the metro speed and its arrival time.

THE HISTORY

In bullet points, describe the current situation.

- Delhi's Air Quality Index has been deteriorating for years & now there's an urgency to cut carbon emission. One thing which we can do is to increase the use of public transport. Metros have been there for years but still, people have reservations when it comes to using them in times of urgency. This has been caused due to irregular timing of arrival of metros, and lack of knowledge of metro routes and lines.

LIMITATIONS

List what could prevent the success of the project, such as the need for expensive equipment, bad weather, lack of special training, etc.

- The Project will be requiring expensive GPS systems to be installed in metros and an active internet connection to send the data over the cloud server.
- As we plan to provide an efficient & a long lasting solution, the embedded device will require a high quality durable power supply(batteries).

APPROACH

List what is needed to complete the project.

- Approval of the Government.
- Large scale GPS tracking system is required.
- Association with a map application (**FOR EXAMPLE:-** GOOGLE MAPS)

BENEFITS

In bullet points, list the benefits that this project will bring to the organization.

- It reduces the waiting time.
- People can check the cost of travel beforehand, so that they can plan accordingly.
- This app would make public transport much more reliable, hence encouraging more people to choose this mode of transportation. On a larger scale, This could help in reducing the air pollution across the city.

Result

Thus, the project team formed, the project is described, the business case was prepared and the problem statement was arrived.

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Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	2
Title of Experiment	Identification of Process Methodology and Stakeholder Description
Name of the candidate	Arnav Aggarwal
Team Members	Rohit Kumar, Navdeep Singh Takhar
Register Number	RA2111032010002
Date of Experiment	31/01/2023

Mark Split Up

S.No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	5
	Total	**10**	10

Staff Signature with date

Aim

To identify the appropriate Process Model for the project and prepare Stakeholder and User Description.

Team Members:

Sl No	Register No	Name	Role
1	RA2111032010002	Arnav Aggarwal	Rep/Member
2	RA2111032010009	Ronit Kumar	Member
3	RA2111032010002	Navdeep Jhakar	Member

Project Title: Live Tracking System for DMRC Metro

Selection of Methodology

In the context of a Live Tracking System for Delhi Metro Rail Corporation (DMRC) Metro project, the Agile approach could be applied as follows:

Requirements Gathering: The team would work with stakeholders such as DMRC, passengers, and other relevant parties to gather requirements for the Live Tracking System.
Sprint Planning: The team would then plan out the development process in short sprints, typically lasting 1-4 weeks. Each sprint would have a set of specific goals to be achieved.
Development and Testing: During each sprint, the team would work on developing and testing the Live Tracking System. The Agile approach emphasizes collaboration and continuous feedback, so the team would regularly review progress and make changes as needed.
User Acceptance Testing: At the end of each sprint, the team would demonstrate the Live Tracking System to stakeholders for feedback and approval.
Deployment: Once all sprints are complete and the Live Tracking System meets all requirements, it would be deployed for use by passengers.
The Agile methodology offers several benefits for a project like the Live Tracking System for DMRC Metro, including increased flexibility, better collaboration, and faster delivery.

StakeHolders:

Stakeholder Name	**Activity/ Area /Phase**	**Interest**	**Influence**	**Priority (High/ Medium/ Low)**
Team Members	Upskilling and application of existing skillset	High	High	1
Project Manager	Lead the team in every aspect and be completely accountable for the success and failure of the project	High	High	2
Development Lead	Improving and applying coding skills and developing an efficient web application	High	High	3
Tester	A tester checks the work of the development team.	Medium	Medium	5
Investor	Provides all the necessary investment for the website to run	Medium	Medium	4
End User	Provides constructive criticism	Low	Low	6
Passenger	The end-users of the system, who will use the live tracking information to plan their trips and keep track of the train's real-time status.	High	High	5
Train Operator	Responsible for ensuring the smooth running of the trains and using the live tracking information to manage resources efficiently.	Medium	Medium	6
Government	Regulator of public transportation,	Medium	High	7

	interested in ensuring that the live tracking system meets the necessary safety and security standards.			
Tourists	Visitors to the city who may use the metro as a means of transportation, interested in real-time information on train schedules and locations.	High	Medium	7
Commuters	Individuals who use the metro for daily travel, interested in real-time information on train schedules and delays.	Medium	Medium	6

Result

Thus the Project Methodology was identified and the stakeholders were described.

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School of Computing

SRM IST, Kattankulathur – 603 203

Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	3
Title of Experiment	System, Functional and Non-Functional Requirements of the Project
Name of the candidate	Annar Aggarwal
Team Members	Ronit Kumar, Navdeep Singh Jakhar
Register Number	RA2111032010002
Date of Experiment	07.02.2023

Mark Split Up

S.No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	5
	Total	**10**	10

P. Santhana 14/2/2023

Staff Signature with date

Aim

To identify the system, functional and non-functional requirements for the project.

Team Members:

S No	Register No	Name	Role
1	RA2111032010002	Arnav Aggarwal	Rep/Member
2	RA2111032010009	Ronit Kumar	Member
3	RA2111032010030	Navdeep Singh Jakhar	Member

Project Title: Live Tracking System for DMRC Metro

System Requirements

- **Hardware:** The system should be able to run on appropriate hardware, such as servers, edge devices, and sensors, depending on the requirements of the deployment.
- **Operating system:** The system should be compatible with popular operating systems, such as Windows, Linux, and iOS.
- **Network infrastructure:** The system should be able to work with different network infrastructure, including Wi-Fi, cellular, and satellite, depending on the requirements of the deployment.
- **Data communication:** The system should support various data communication protocols, such as MQTT, HTTP, and CoAP, for efficient and secure data transfer.
- **Data processing:** The system should be able to process large amounts of data in real-time, using appropriate data processing technologies, such as edge computing and cloud computing.
- **Data storage:** The system should have a reliable data storage solution, such as databases or cloud storage, to store and retrieve the data.
- **Analytics:** The system should have analytics capabilities, such as machine learning and predictive analytics, to provide valuable insights and analysis of the data.

- **User interface:** The system should have a user-friendly interface, such as a web portal or mobile app, for accessing the live tracking information.
- **Integration:** The system should be able to integrate with other systems used by the metro system, such as fare collection systems and passenger information systems.
- **Maintenance:** The system should have a maintenance plan in place to ensure smooth operation and timely updates and upgrades.

Functional Requirements

- **GPS tracking:** The system should have the capability to track the location of the metro trains using GPS.
- **Real-time data:** The system should provide real-time data on the location, speed, and direction of the metro trains.
- **Data visualization:** The system should provide data visualization tools for presenting the data in an intuitive manner.
- **Data sharing:** The system should allow for data sharing between different departments and stakeholders.
- **Alerts and notifications:** The system should provide alerts and notifications in case of any deviations from the normal operating parameters.

Non-Functional Requirements

- **Scalability:** The system should be scalable to accommodate the growing needs of the metro system.
- **Performance:** The system should have high performance, with minimal latency and high availability.
- **Security:** The system should have strong security features to ensure the confidentiality and integrity of the data.
- **Reliability:** The system should have high reliability, with minimal downtime and maintenance requirements.
- **Compliance:** The system should comply with relevant industry standards and regulations.

- **Interoperability:** The system should be interoperable with other systems and technologies used by the metro system.
- **User experience:** The system should provide a good user experience, with intuitive navigation and easy-to-use features.

Result

Thus the requirements were identified and accordingly described.

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Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	4
Title of Experiment	Prepare Project Plan based on scope, Calculate Project effort based on resources and Job roles and responsibilities
Name of the candidate	Arnav Aggarwal
Team Members	Ronit Kumar, Navdeep Singh Jakhar
Register Number	RA2111032010002
Date of Experiment	14.02.2023

Mark Split Up

S.No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	5
	Total	**10**	10

Staff Signature with date

Aim

To Prepare Project Plan based on scope, Calculate Project effort based on resources, Find Job roles and responsibilities

Team Members:

Sl No	Register No	Name	Role
1	RA2111032010002	Arnav Aggarwal	Lead
2	RA2111032010009	Ronit Kumar	Member
3	RA2111032010030	Navdeep Singh Jakhar	Member

1. Project Management Plan

Focus Area	Details
Scope Management	The objective of this project is to develop a mobile application that provides live tracking of Delhi Metro trains for commuters. The application will display real-time location of trains, expected arrival time at stations, and other related information to help users plan their commute more efficiently.
Schedule Management	A hierarchical decomposition of the project scope into smaller, manageable work packages to facilitate scheduling and control. A process for providing regular reports to project stakeholders on the status of the project schedule, including updates on progress, risks, and issues. process for optimizing the project schedule to improve efficiency, minimize delays, and reduce costs, while maintaining the required quality standards.
Quality Management	A plan for defining quality standards and identifying the processes, resources, and activities required to meet these standards.A plan for conducting rigorous testing and validation of the live tracking system to ensure that it meets the required quality standards and is fully functional.By implementing these quality management processes, DMRC can ensure that the live tracking system for their metro is reliable, efficient, and meets the needs of their passengers.

Resource Management	A plan for managing the resources required to complete the project, including personnel, equipment, and budget.
Stakeholder	A plan for identifying and managing the expectations of all project stakeholders, including project sponsors, customers, and end-users.

2. Estimation

2.1. Effort and Cost Estimation

Activity Description	Sub-Task Description	Effort (in hours)	Cost in INR
Application Development	Create a mobile application	12	1,00,000
Database Management	Database management, data analysis	18	80,000
User Support	User help and support	8 hours shift per day	20,000 (per person)
Legal	Legal work related to Terms & Conditions, Registration, and Trademark	As required	60,000

Effort (hr)	Cost (INR)
1	500

2.2. Infrastructure/Resource Cost [CapEx]

Infrastructure Requirement	Qty	Cost per qty	Cost per item
IOT GPS TRACKING DEVICE	100	4,500	4,50,000
DATABASE SOFTWARE	1	1,25,000	1,25,000

2.3 Maintenance and Support Cost [OpEx]

Category	Details	Qty	Cost per qty per annum	Cost per item
People	Database administrator, Application manager	2	60,000	30,000
Infrastructures	Server, Storage and Network	10	1,00,000	35,000

3. Project Team Formation

3.1. Identification Team members

Name	Role	Responsibilities
Arnav Aggarwal	Project Manager	Responsible for overall project planning, budgeting, and management. Leads the project team and coordinates with stakeholders to ensure project success.
Navdeep Singh Jakhar	Business Analyst	Responsible for requirements gathering and analysis, system design, and documentation.
Ronit Kumar	UI/UX Designer	Responsible for designing the mobile application's user interface and user experience, including wireframes, mockups and prototypes.
Ronit Kumar	Backend Developer	Responsible for developing the server and database for storing and processing data, and integrating with DMRC's train scheduling and tracking systems.
Arnav Aggarwal	Quality Assurance Engineer	Design the cost effective, highly available and scalable architecture
Navdeep Singh Jakhar	Technical Writer	Responsible for creating user manuals and documentation for the mobile application.

3.2. Responsibility Assignment Matrix

RACI Matrix	Team Members			
Activity	**Project Manager**	**Developer**	**Quality Assurance Engineer**	**Business Analyst**
Project planning	A/I	C	R	C
System design		C		
Back-end development		A\R	C	
Database design		R		
Quality Assurance Testing	A/I	C	R	
Deployment and maintenance	A/I	C	C	C

A	Accountable
R	Responsible
C	Consult
I	Inform

Result:

Thus, the Project Plan was documented successfully.

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Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	5
Title of Experiment	Prepare Work breakdown structure, Timeline chart, Risk identification table
Name of the candidate	Arnav Aggarwal
Team Members	Rohit Kumar, Navdeep Singh Jakhar
Register Number	RA2111032010002
Date of Experiment	02.02.23

Mark Split Up

S.No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	4
	Total	**10**	9

P. Gowthaman 7/3/2023

Staff Signature with date

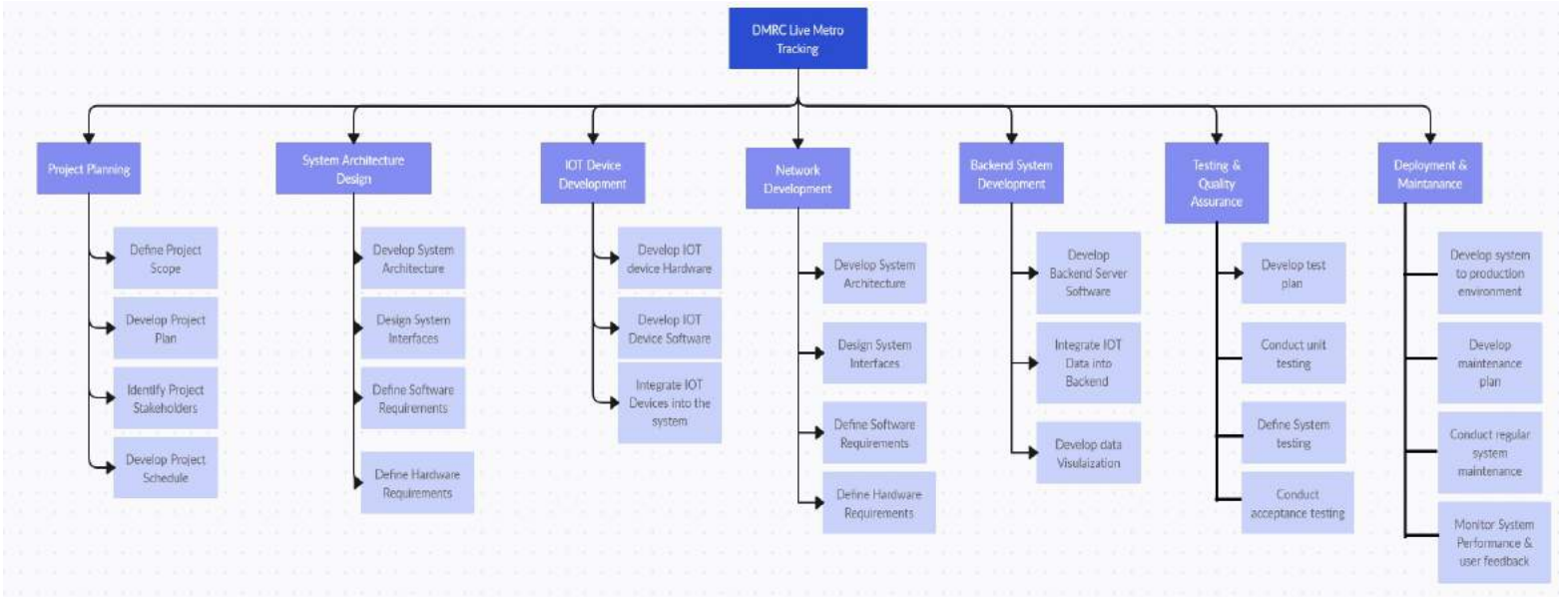
Aim

To Prepare Work breakdown structure, Timeline chart and Risk identification table

Team Members:

Sl No	Register No	Name	Role
1	**RA2111032010002**	Arnav Aggarwal	**Rep**
2	**RA2111032010009**	Ronit Kumar	**Member**
3	**RA2111032010030**	Navdeep Singh Jakhar	**Member**

Work Breakdown Structure:



Project Planning

- Define project scope
- Develop project plan
- Identify project stakeholders
- Develop project schedule

System Architecture Design

- Develop system architecture
- Design system interfaces
- Define hardware requirements
- Define software requirements

IoT Device Development

- Develop IoT device hardware
- Develop IoT device software
- Integrate IoT devices into the system

Network Development

- Develop network architecture
- Configure network devices
- Test network connectivity

Backend System Development

- Develop backend server software
- Integrate IoT data into the backend system
- Develop data visualization and reporting tools

Testing and Quality Assurance

- Develop test plan
- Conduct unit testing
- Conduct system testing

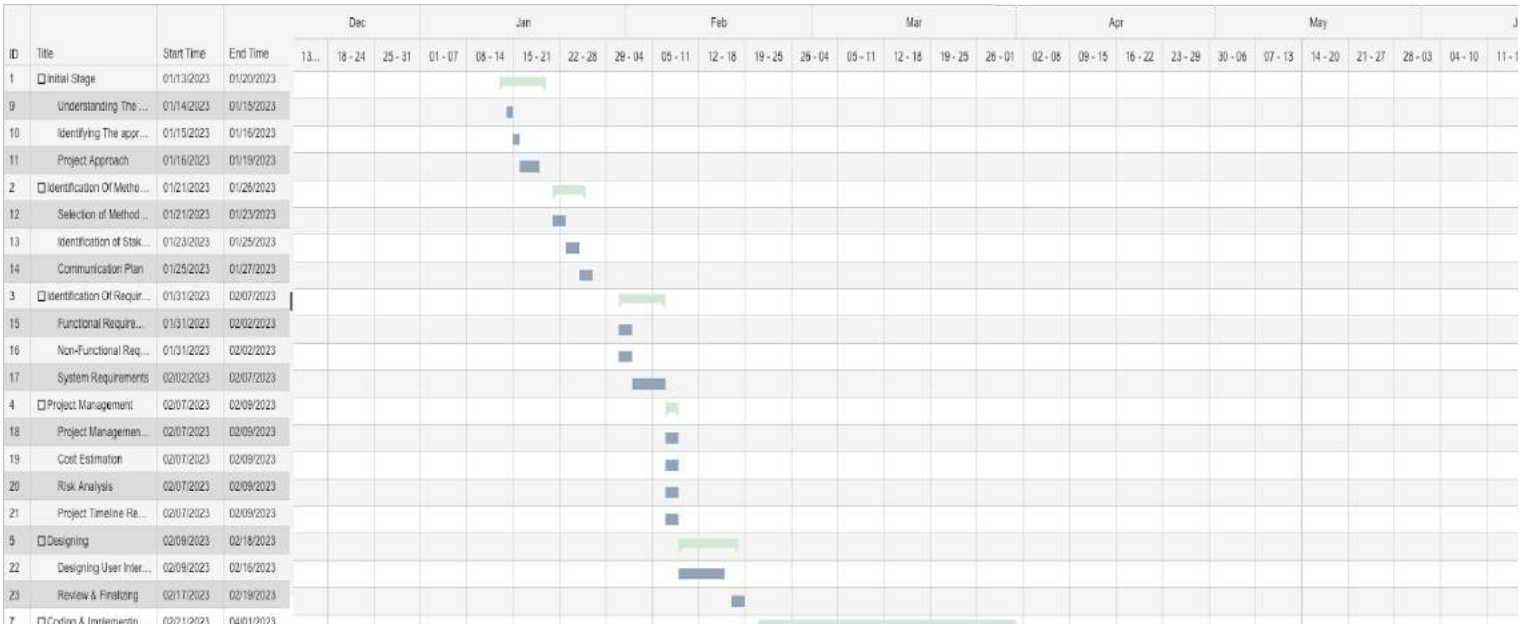
- Conduct acceptance testing

Deployment and Maintenance

- Deploy system to production environment
- Develop maintenance plan
- Conduct regular system maintenance
- Monitor system performance and user feedback

Timeline

Gantt Chart



Risk Analysis

1) SWOT Analysis:

2) RMMM:

Risk:

- Network connectivity issues leading to data loss or delay
- Malfunctioning of IoT devices leading to inaccurate tracking data
- Security vulnerabilities leading to unauthorized access to system and data
- Unforeseen technical difficulties and system failures

Mitigation:

- Employing redundancy and backup mechanisms to minimize the impact of network connectivity issues and device malfunctioning
- Implementing robust security measures such as encryption and access controls to safeguard against security threats
- Thorough testing and quality assurance processes to identify and mitigate technical difficulties and system failures before deployment
- Regular maintenance and monitoring of the system to detect and address any potential issues before they escalate

Monitoring:

- Real-time monitoring of network connectivity and device performance to ensure accurate and timely tracking data
- Regular security audits and vulnerability assessments to detect and address potential security threats
- Continuous monitoring of the system for technical difficulties and system failures

Management:

- Clearly defining roles and responsibilities for system management and maintenance
- Implementing change management processes to ensure any changes to the system are thoroughly tested and validated before deployment
- Regularly reviewing and updating the RMMM plan to address any emerging risks or issues

Result:

Thus, the work breakdown structure with timeline chart and risk table were formulated successfully.

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Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	6
Title of Experiment	Design a System Architecture, Use Case and Class Diagram
Name of the candidate	Aanav Aggarwal
Team Members	Rohit Kumar, Navdeep Singh Takhar
Register Number	RA2111032010002
Date of Experiment	28.02.2023

Mark Split Up

S.No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	5
	Total	**10**	10

P. Sam Thangaraj 13/3/2023

Staff Signature with date

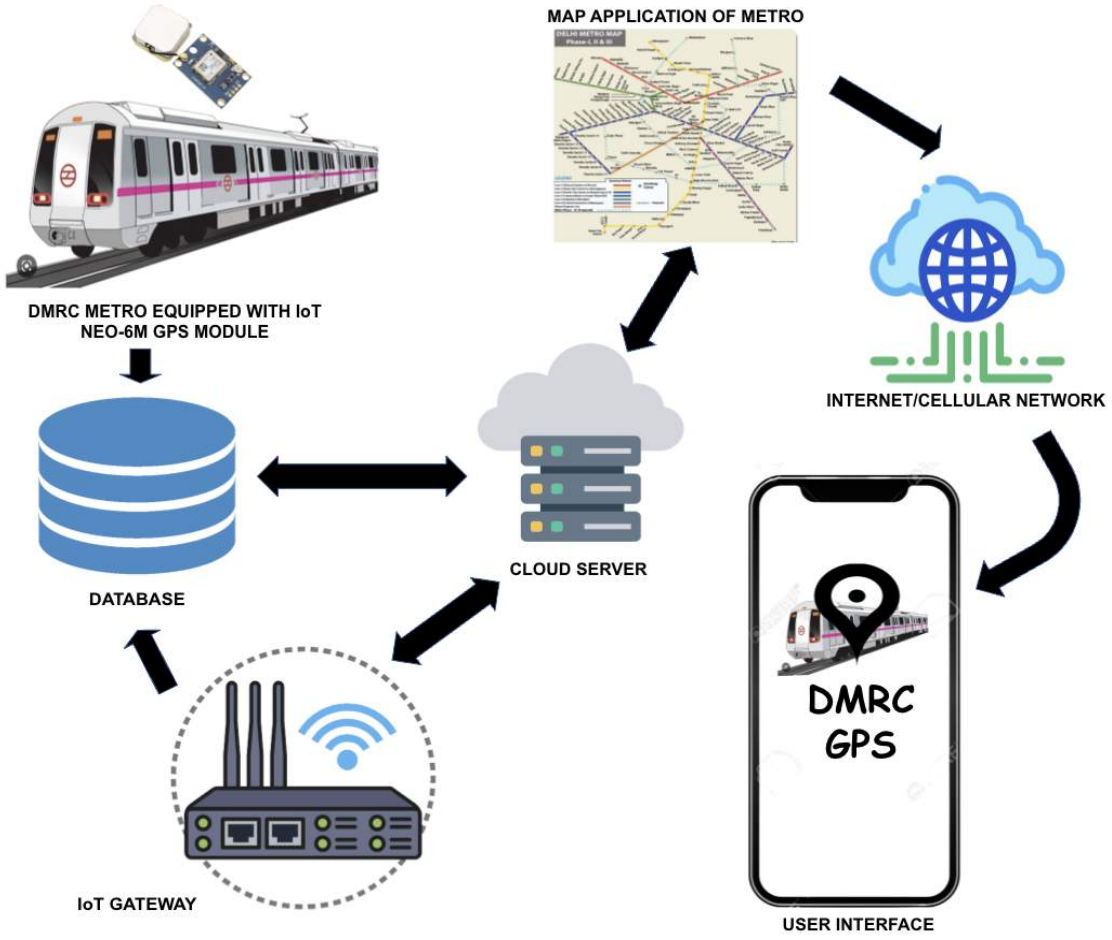
Aim

To Design a System Architecture, Use case and Class Diagram

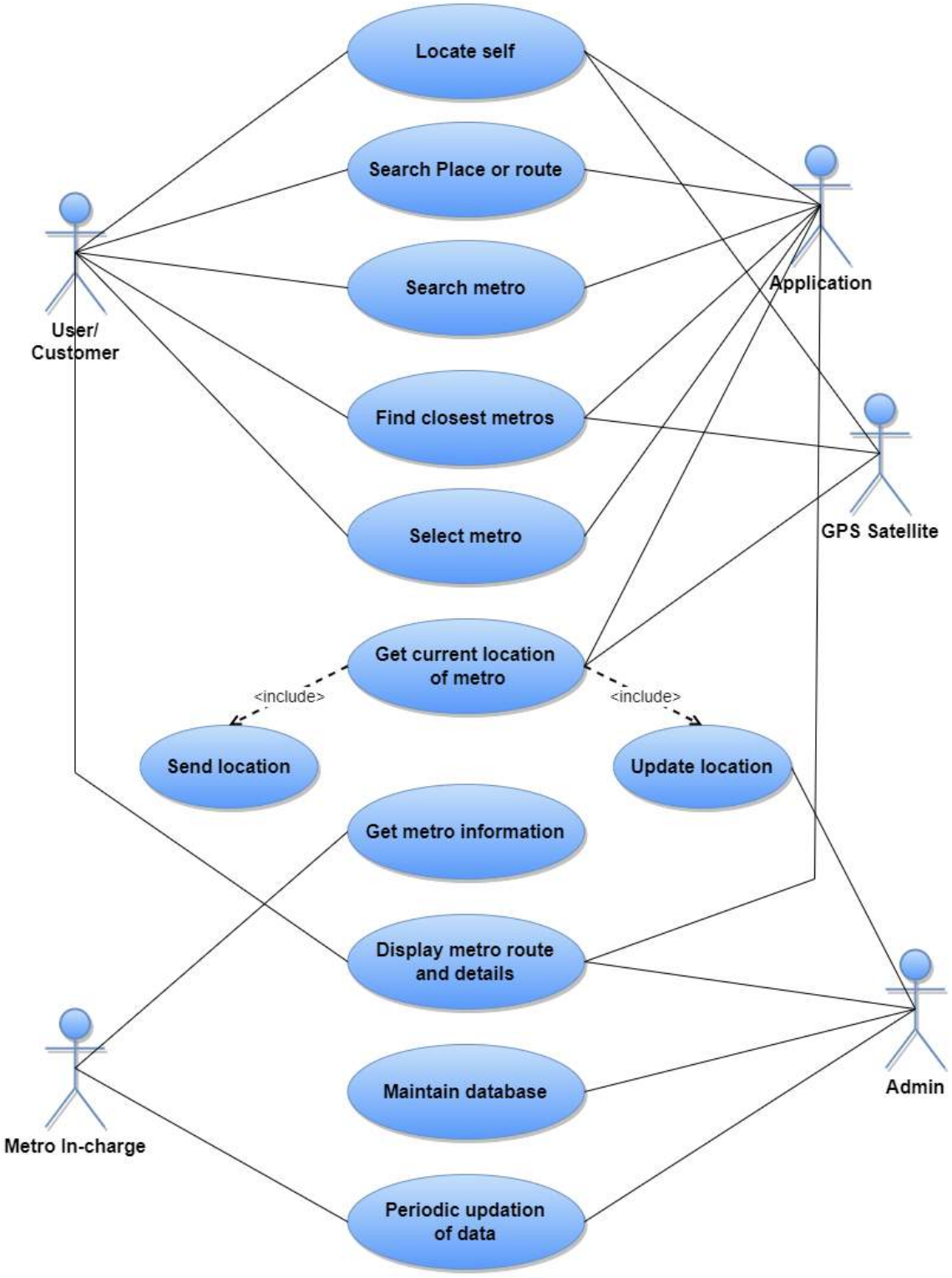
Team Members:

Sl No	Register No	Name	Role
1	RA2111032010002	Arnav Aggarwal	Rep
2	RA2111032010009	Ronit Kumar	Member
3	RA2111032010030	Navdeep Singh Jakhar	Member

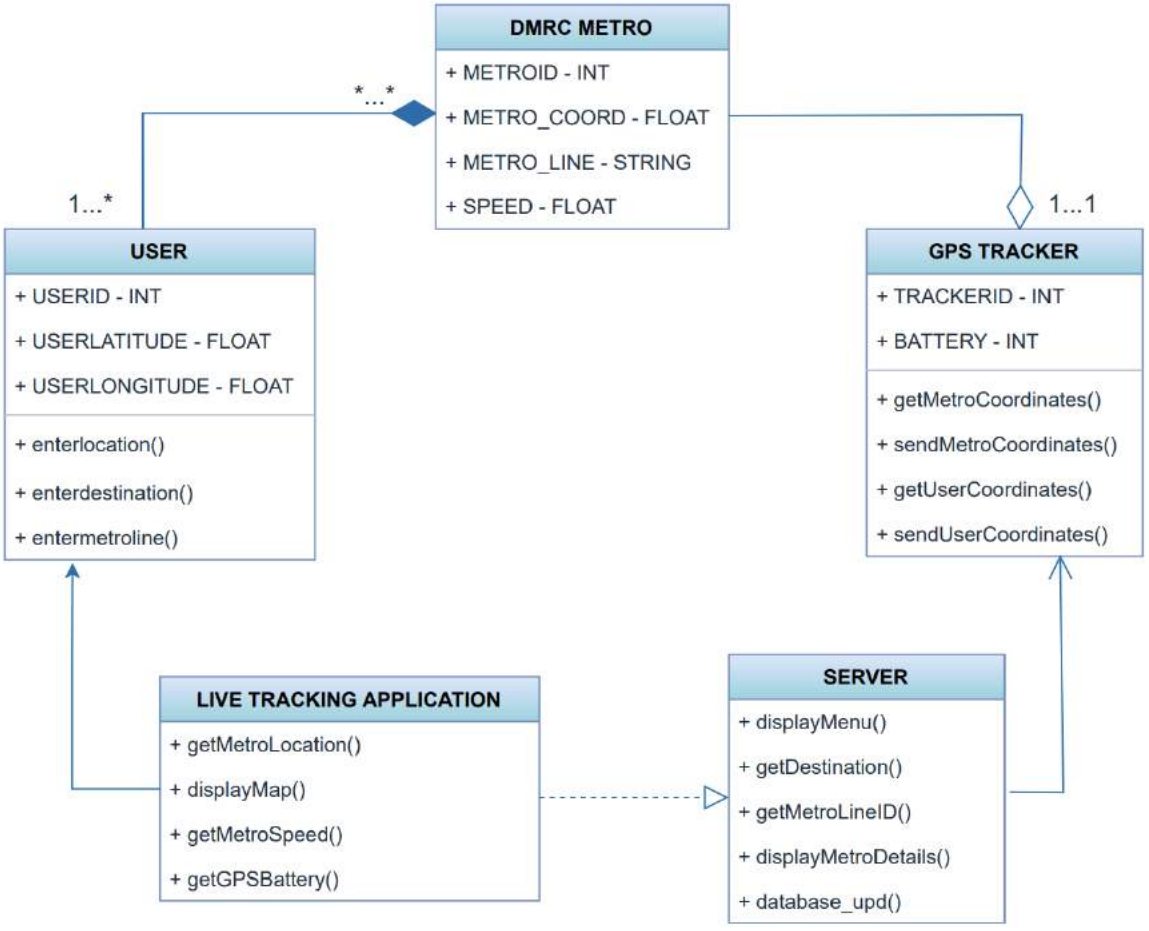
SYSTEM ARCHITECTURE



USE CASE DIAGRAM



CLASS DIAGRAM



Result:

Thus, the system architecture, use case and class diagram created successfully.

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Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	7
Title of Experiment	Design a Entity relationship diagram
Name of the candidate	Arnav Aggarwal
Team Members	Rohit Kumar, Nardeep Singh Jakhar
Register Number	RA2111032010002
Date of Experiment	05.03.2023

Mark Split Up

S. No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	4
	Total	**10**	9

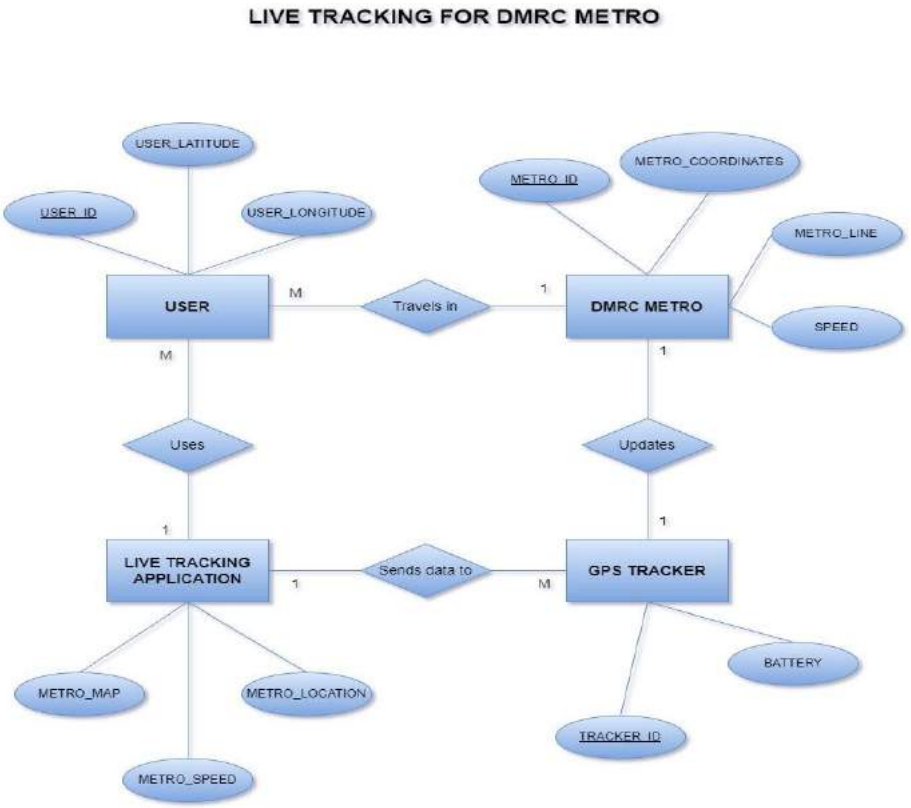
P. Gowthaman 5/3/2023
Staff Signature with date

Aim

To create the Entity Relationship Diagram

Team Members:

S No	Register No	Name	Role
1	RA2111032010002	Arnav Aggarwal	Rep
2	RA2111032010009	Ronit Kumar	Member
3	RA2111032010030	Navdeep Singh Jakhar	Member



Result:

Thus, the entity relationship diagram was created successfully.

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SRM IST, Kattankulathur – 603 203

Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	8
Title of Experiment	Develop a Data Flow Diagram (Process-Up to Level 1)
Name of the candidate	Arnav Aggarwal
Team Members	Rohit kumar, Navdeep Singh Jakhar
Register Number	RA2111032010002
Date of Experiment	16.03.2023

Mark Split Up

S. No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	5
	Total	**10**	10

P. Gowtham 30/3/2023

Staff Signature with date

Aim

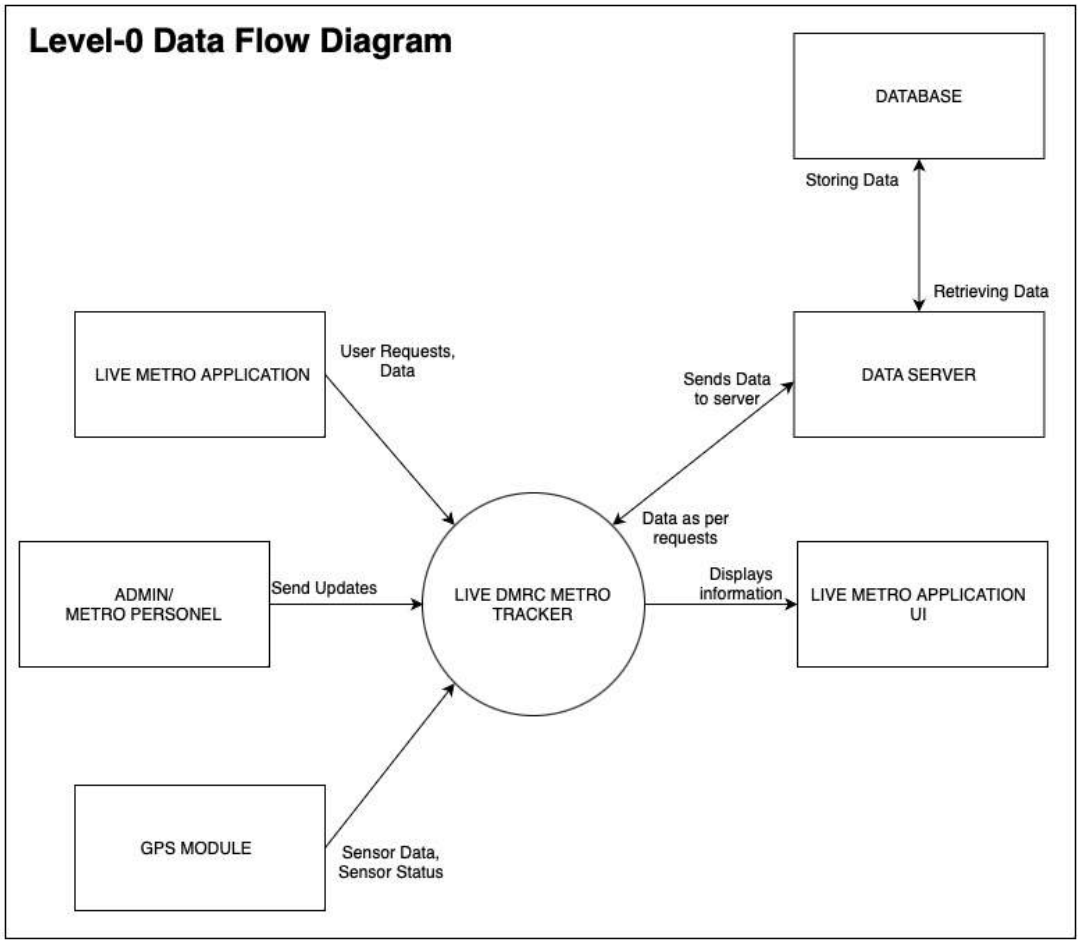
To develop the data flow diagram up to level 1 for the <project name>

Team Members:

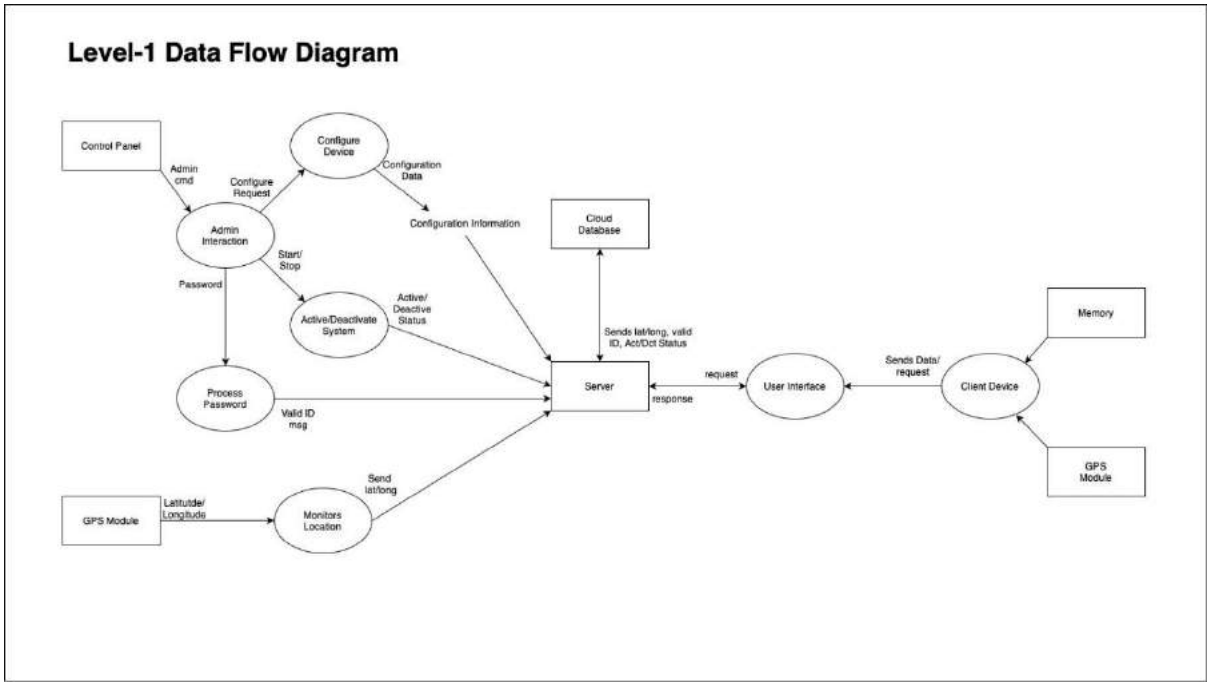
S No	Register No	Name	Role
1	RA2111032010002	Arnav Aggarwal	Rep
2	RA2111032010009	Ronit Kumar	Member
3	RA2111032010030	Navdeep Singh Jakhar	Member

Data Flow Diagram:

- **DFD Level 0**



➢ **DFD Level 1**



Result:

Thus, the data flow diagrams have been created for the Live DMRC Metro Tracking System.

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SRM IST, Kattankulathur – 603 203

Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	9
Title of Experiment	Design a Sequence and Collaboration Diagram
Name of the candidate	Arnav Aggarwal
Team Members	Rohit Kumar, Navdeep Singh Jakhar
Register Number	RA2111032010002
Date of Experiment	23.03.2023

Mark Split Up

S. No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	4
	Total	**10**	9

30/3/2023
Staff Signature with date

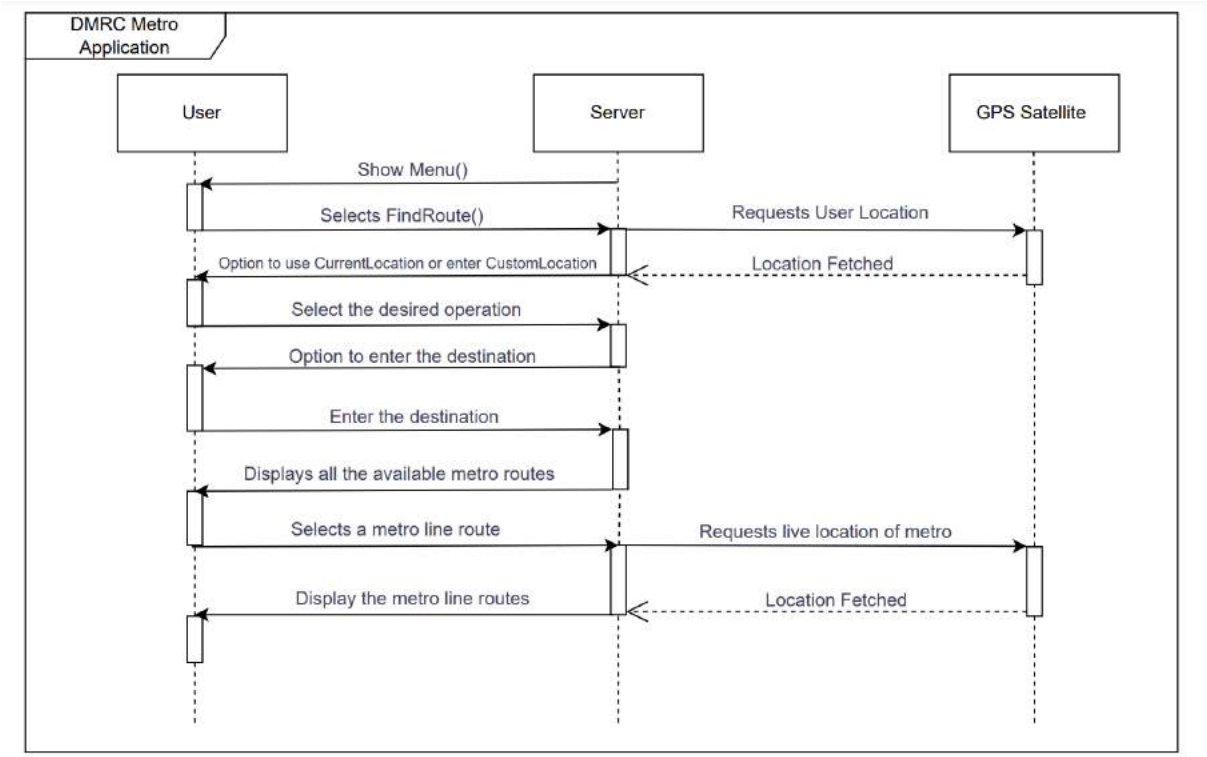
Aim:

To create the sequence and collaboration diagram for the Live Tracking System of DMRC Metro.

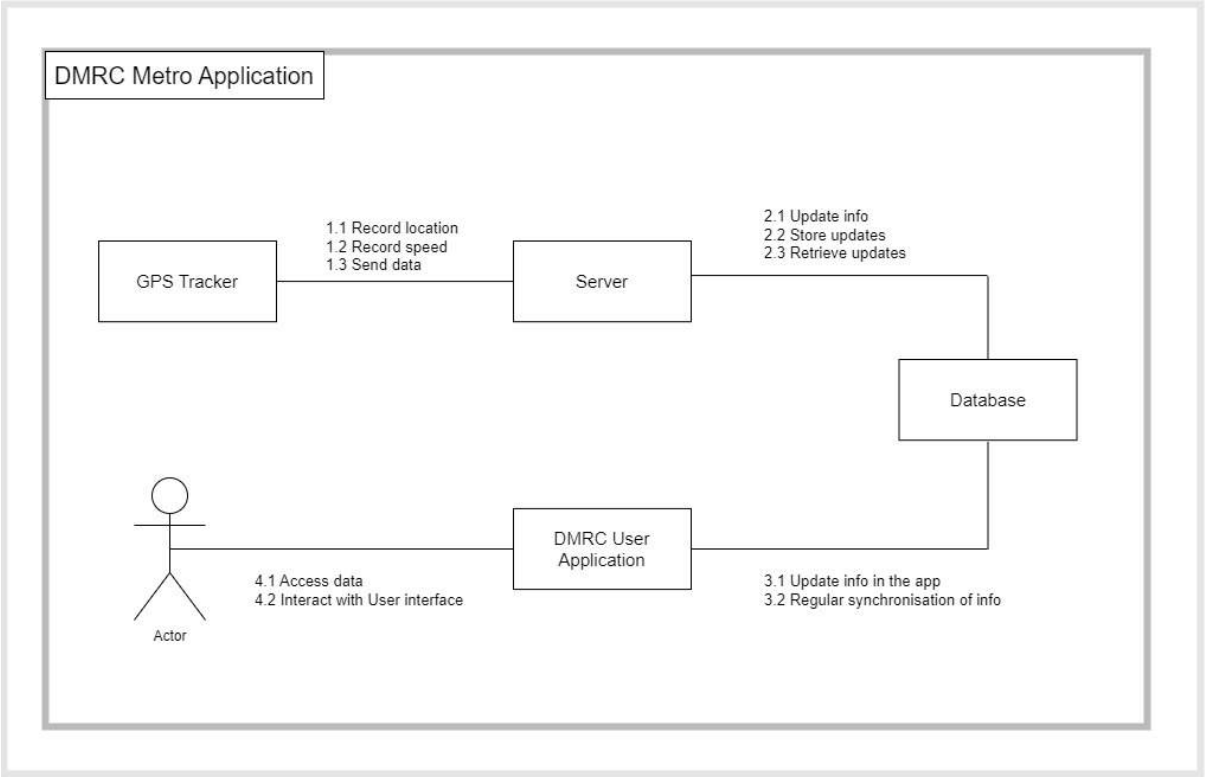
Team Members:

S No	Register No	Name	Role
1	RA2111032010002	Arnav Aggarwal	Rep/Member
2	RA2111032010009	Ronit Kumar	Member
3	RA2111032010030	Navdeep Singh Jakhar	Member

1.SEQUENCE DIAGRAM



2.COLLABORATION DIAGRAM



Result:

Thus, the sequence and collaboration diagrams were created for the Live Tracking System of DMRC Metro.

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School of Computing

SRM IST, Kattankulathur – 603 203

Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	10
Title of Experiment	Develop a Testing Framework/User Interface
Name of the candidate	Arrav Aggarwal
Team Members	Ronit Kumar, Navdeep Singh Jakhar
Register Number	RA2111032010002
Date of Experiment	06.04.2023

Mark Split Up

S. No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	5
	Total	**10**	10

P. Gowthaman 27/4/2023

Staff Signature with date

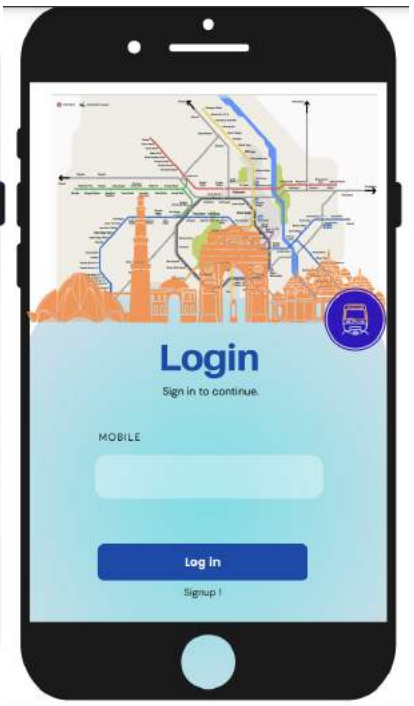
Aim

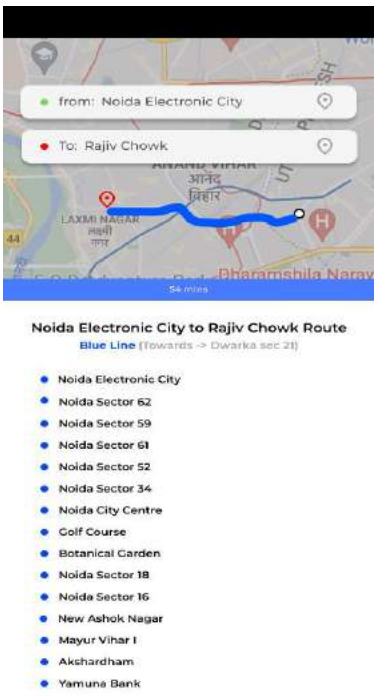
To develop the testing framework and/or user interface framework for the DMRC Metro Live-Tracking system.

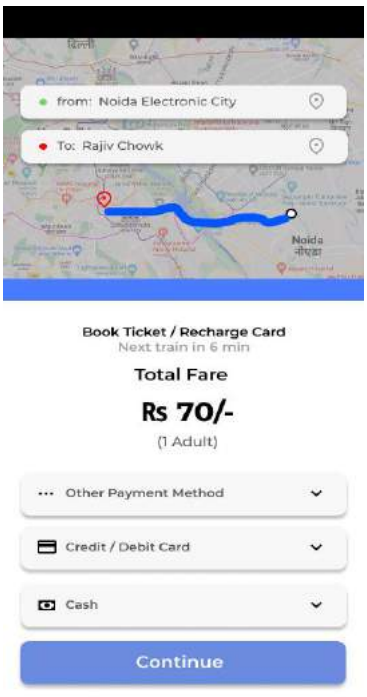
Team Members:

S No	Register No	Name	Role
1	RA2111032010002	Arnav Aggarwal	Rep/Member
2	RA2111032010009	Ronit Kumar	Member
3	RA2111032010030	Navdeep Singh Jakhar	Member

User Interface:







Executive Summary:

The DMRC metro tracking app using IoT is a software application designed to provide real-time tracking and updates for metro trains and passengers. The objective of testing this application is to ensure that it meets all functional and non-functional requirements, including real-time tracking, the accuracy of data processing, performance under high volume, security, usability, and compatibility.

The approach to testing this application involves a comprehensive and well-designed testing plan that covers all critical areas of functionality and performance. This testing plan includes functional testing to ensure the app meets all functional requirements, performance testing to ensure it can handle a high volume of users and data, security testing to protect user data against cyber-attacks, usability testing to ensure the user interface is user-friendly and accessible, and compatibility testing to ensure the app works with the IoT platform and other third-party tools and services.

Additionally, non-functional testing areas such as performance, availability, scalability, reliability, and compliance are also included in the testing plan to ensure that the application meets all necessary standards and requirements.

Overall, the testing plan for the DMRC metro tracking app using IoT is designed to ensure that the application functions efficiently and effectively and meets all the necessary requirements and standards for functionality, performance, security, and usability. The use of appropriate methodologies and tools will help ensure that the testing process is thorough, efficient, and effective.

Scope of testing:

The scope of testing for the DMRC metro tracking app using IoT should cover a range of functional and non-functional testing areas, including:

- Functionality testing to ensure the app meets all functional requirements, such as real-time tracking of metro trains and passengers, the ability to provide real-time updates and notifications, and accurate data processing.
- Performance testing to ensure the app can handle a high volume of users and data without crashing or experiencing significant delays.
- Security testing to ensure the app is secure and that user data is protected against cyber attacks.
- Usability testing to ensure the user interface is user-friendly, accessible, and compatible with different devices and screen sizes.
- Compatibility testing to ensure the app is compatible with the IoT platform and other third-party tools and services.
- Regression testing to ensure any updates or changes made to the app do not negatively impact existing functionality or performance.

- Non-functional testing areas, including performance, availability, scalability, reliability, and compliance.

The choice of specific testing methodologies and tools will depend on the requirements and goals of the project, as well as the expertise of the testing team. However, a comprehensive and well-designed testing plan that covers all the critical areas will help ensure the DMRC metro tracking app using IoT meets the necessary standards for functionality, performance, security, and usability.

Functional:

Functional testing scope for the DMRC metro tracking app using IoT would include testing the following areas:

- Real-time tracking of metro trains and passengers.
- Ability of the app to provide real-time updates and notifications to users.
- Integration of sensors to collect data on the location of metro trains and passengers.
- Accuracy of the data collected and processed by the app.
- Integration of third-party tools and services, such as the IoT platform and cloud services.
- Compatibility of the app with different devices and screen sizes.
- User authentication and access control.
- Reporting and analysis of data collected by the app.
- Functionality of the app under different usage scenarios.

Non-functional:

Non-functional testing scope for the DMRC metro tracking app using IoT would include testing the following areas:

- Performance of the app under different load conditions.
- Response time of the app for different user requests.
- Availability of the app under different usage scenarios.
- Security of the app, including data privacy and protection against cyber-attacks.
- Usability and accessibility of the user interface framework.
- Compatibility of the app with different platforms and operating systems.
- Scalability of the app to handle increasing users and data.
- Reliability and stability of the app under different environmental conditions.

Overall, the functional and non-functional testing scope for the DMRC metro tracking app using IoT should be considered to ensure that the app meets all the requirements, goals, and standards of the project.

Types of Testing, Methodology, Tools

Category	Methodology	Tools Required
Functionality	Functional	Selenium
Performance	Load, stress	JMeter
Security	Vulnerability, Compliance	Burp Suite
Usability	Usability, Accessibility	UserTesting
Compatibility	Compatibility	Sauce labs
Regression	Regression	Regression Tester
Performance	Performance	New Relic
Availability	Availability	Zabbix
Scalability	Scalability	Docker
Reliability	Reliability	Chaos Monkey

Result:

Thus, the testing framework/user interface framework has been created for the DMRC Metro live-tracking system.

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SRM IST, Kattankulathur – 603 203

Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	11
Title of Experiment	Test Cases & Reporting
Name of the candidate	Arnav Aggarwal
Team Members	Rohit Kumar, Navdeep Singh Takhar
Register Number	RA2111032010002
Date of Experiment	18.04.2023

Mark Split Up

S. No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	5
	Total	**10**	10

17/4/2023

Staff Signature with date

Aim

To develop the test cases manual with manual test case report for the Live Tracking System for DMRC Metro.

Team Members:

S No	Register No	Name	Role
1	RA2111032010002	Arnav Aggarwal	Rep
2	RA2111032010009	Ronit Kumar	Member
3	RA2111032010030	Navdeep Singh Jakhar	Member

Test Case

Functional Test Cases

Test ID (#)	Test Scenario	Test Case	Execution Steps	Expected Outcome	Actual Outcome	Status	Remarks
FTC_01	User login	Valid login	1. Enter a valid username and password. 2. Click on the login button.	User should be logged in successfully and redirected to the home page.	Login Successful	Passed	Success
FTC_02	User login	Invalid login	1. Enter invalid username and/or password. 2. Click on the login button.	User should see an error message indicating that the login details are incorrect.	Login unsuccessful	Failed	Failure
FTC_03	Finding route to destination	Route found	1. Enter your location. 2. Enter your destination. 3. Click on the 'Find route' button.	User should be brought to the metro timings page.	Route found successfully.	Passed	Success
FTC_04	Finding route to destination	Route not found	1. Enter your location. 2. Enter incorrect destination. 3. Click on the 'Find route' button.	User should see an error message indicating that they've entered or selected an incorrect or out-of-service destination.	Route not found.	Failed	Failure
			1. Scroll through the many metro	User should be able to select the a		Passed	Success

FTC_05	Metro Timings	Correct time	timings shown on the screen. 2. Select the one most convenient to you.	particular metro if it is present in the list. Then, the user should be brought to the ticketing page.	Metro selected.		
FTC_06	Metro timings	Incorrect time or unable to select metro	1. Scroll through the many metro timings shown on the screen. 2. Try to select a metro but you're unable to due to some reason.	Error message is shown to user requesting them to wait till the issues are fixed.	Metro selection failed.	Failed	Failure
FTC_07	Ticket price payment	Successful payment	1. Ticket price is shown to the user. 2. The user pays the amount and receives ticket booking confirmation.	The ticket is successfully bought and confirmation is received.	Ticked bought.	Passed	Success
FTC_08	Ticket price payment	Unsuccessful payment	1. Ticket price is shown to the user. 3. The user is not able to pay or does not receive confirmation.	Error message is shown asking the user to either retry payment or wait for it to be processed, according to the situation.	Ticket not bought.	Failed	Failure

Non-Functional Test Cases

Test ID (#)	Test Scenario	Test Case	Execution Steps	Expected Outcome	Actual Outcome	Status	Remarks
NFTC_01	Performance Testing	Response time	Increase the number of users accessing the application simultaneously to a certain threshold.	The application should not crash or slow down,and should continue to work properly.	The application slowed down and took longer to respond as the number of users increased.	Fail	A need for optimization to improve system performance.
NFTC_02	Security Testing	Data Protection	Test the application vulnerabilities and ensure that it meets all security standards and regulations.	The application should be secure and protected against hacking and unauthorized access, and data breaches.	No security vulnerabilities were found.	Pass	Application met all security standards and regulations.
NFTC_03	Usability Testing	User Interface	Test the application for ease of navigation, clarity of information and overall user experience.	The application should be user-friendly and easy to use for passengers, DMRC staff,and other authorities concerned.	The application was found to be user-friendly and easy during testing.	Pass	The user interface is intuitive.
NFTC_04	Compatibility Testing	Compatibility	Test the application on different devices, platforms, and operating systems.	The application should function properly on different devices and platforms.	The application functioned properly on different devices, platforms,and operating systems.	Pass	The application was compatible on all the tested devices.

NFTC_05	Maintenance Testing	Maintainability	Test the application's ability to be easily maintained, updated, and repaired in case of a malfunction or failure.	The application should be easy to maintain, update, and repair.	The application was found to be easy to maintain, update, and repair during testing.	Pass	The application was easy to maintain during testing.

Manual Test Case Report

Test Case ID	**FTC_01**	**FTC_02**
Test Case Name	User Login - Valid Login	Finding Route to Destination
Test Objective	To verify that a user can log in to the online app using valid login credentials.	To verify if user can find a shortest route to his/her desired location.
Test Steps	1. Open the mobile app login page. 2. Enter valid login credentials (username and password).3. Click on the "Login" button. Verify that the user is redirected to the home page.	1. Open mobile app log into your account. 2. Turn on mobile GPS to get current location. 3. Ask user to enter desired station. 4. Click on find route.
Expected Result	The user should be able to log in successfully using valid credentials and should be redirected to the home page.	The user should be able to get a list of stations to be followed to get to the desired station.
Actual Result	The user is able to log in successfully and is redirected to the home page.	The user should be able to see the routes to the station, fare of metro and time taken.
Pass/Fail	Pass	Pass
Test Environment	Operating System - Android ,IOS	Oerating System - Android, IOS
Test Data	Username: testuser Password: Test@123	From: Noida Electronic City To: Rajiv Chowk
Test Conclusion	The user login functionality of the has been tested successfully with valid credentials.	The finding route feature was working succesfully and test was accomplished.

Category	Progress Against Plan	Status
Functional Testing	Amber	In-Progress
Non-Functional Testing	Red	Not-started

Functional	Test Case Coverage (%)	Status
User Login	100%	Completed
Finding Route	100%	Completed
Metro Timing	60%	In-Progress
Ticket Price System	0%	Not-Started

Present Obstacles

1) Technical Challenges: Implementing IoT-based tracking systems involves several technical challenges such as integrating the various hardware and software components, ensuring real-time data transfer, ensuring data security, and resolving compatibility issues with different devices.
Infrastructure.

2) Challenges: Installing the necessary infrastructure for an IoT-based tracking system can be challenging, especially in existing metro systems where infrastructure may be already in place. This may require significant investments in upgrading the existing infrastructure or building new infrastructure from scratch.

3) Cost: The cost of implementing an IoT-based tracking system can be high due to the need for hardware, software, and infrastructure investments. The cost can also vary depending on the complexity of the system, the number of trains to be tracked, and the coverage area.

4) User Adoption: The success of the DMRC Metro Live Tracking using IoT project will depend on the willingness of users to adopt the technology. If the application is difficult to use or not user-friendly, it may not be accepted by users, leading to low adoption rates.

Result:

Thus, the test case manual and report has been created for the Live Tracking for DMRC Metro.

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Course Code: 18CSC206J

Course Name: Software Engineering and Project Management

Experiment No	12
Title of Experiment	Provide the details of Architecture Design/Framework/ Implementation
Name of the candidate	Arnav Aggarwal
Team Members	Rohit Kumar, Nardeep Singh Jakhar
Register Number	RA2111032010002
Date of Experiment	25.04.2023

Mark Split Up

S. No	Description	Maximum Mark	Mark Obtained
1	Exercise	5	5
2	Viva	5	5
	Total	**10**	10

P. Gunthere 24/4/2023

Staff Signature with date

Aim

To provide the details of architectural design/framework/implementation

Team Members:

S No	Register No	Name	Role
1	RA2111032010002	Arnav Aggarwal	Rep/Member
2	RA2111032010009	Ronit Kumar	Member
3	RA2111032010030	Navdeeep Singh Jakhar	Member

1. GPS TRACKING MODULE

```
#include <TinyGPS++.h>
#include <HardwareSerial.h>

// Set serial ports for GPS and ESP32
#define GPS_SERIAL Serial2
#define ESP_SERIAL Serial

// Create GPS object
TinyGPSPlus gps;

void setup() {
 // Start serial communications for GPS and ESP32
 GPS_SERIAL.begin(9600);
 ESP_SERIAL.begin(115200);
}

void loop() {
 // Read GPS data until a full sentence is received
 while (GPS_SERIAL.available() > 0) {
   gps.encode(GPS_SERIAL.read());
 }
  // Check if valid GPS data is available
 if (gps.location.isValid()) {
   // Get latitude and longitude from GPS
```

```
    float latitude = gps.location.lat();
    float longitude = gps.location.lng();

    // Print latitude and longitude to ESP32 serial monitor
    ESP_SERIAL.print("Latitude: ");
    ESP_SERIAL.print(latitude, 6);
    ESP_SERIAL.print(", Longitude: ");
    ESP_SERIAL.println(longitude, 6);
  }
}
```

2. SHORTEST PATH BETWEEN TWO METRO STATIONS

```
#include <stdio.h>
#include <stdlib.h>
#include<string.h>
#include <limits.h>

// Define the number of stations in the metro system
#define NUM_STATIONS 10

// Define a function to implement Dijkstra's algorithm
void dijkstra(int graph[NUM_STATIONS][NUM_STATIONS], int start, int end, int
shortest_path[])
{
    // Create an array to store the distance from start to each station
    int distance[NUM_STATIONS];
    for (int i = 0; i < NUM_STATIONS; i++) {
        distance[i] = INT_MAX;
    }
    distance[start] = 0;

    // Create an array to store whether each station has been visited
    int visited[NUM_STATIONS] = {0};

    // Visit each station in turn until we reach the end station
    for (int i = 0; i < NUM_STATIONS-1; i++) {
        // Find the station with the smallest distance from start that hasn't been
visited yet
        int min_distance = INT_MAX;
        int current_station = -1;
        for (int j = 0; j < NUM_STATIONS; j++) {
```

```
            if (!visited[j] && distance[j] < min_distance) {
                min_distance = distance[j];
                current_station = j;
            }
        }
        // If we can't reach the end station, return
        if (current_station == -1 || current_station == end) {
            break;
        }
        // Visit the current station and update the distances of its neighbors
        visited[current_station] = 1;
        for (int j = 0; j < NUM_STATIONS; j++) {
            if (!visited[j] && graph[current_station][j] != 0 &&
distance[current_station] + graph[current_station][j] < distance[j]) {
                distance[j] = distance[current_station] + graph[current_station][j];
                shortest_path[j] = current_station;
            }
        }
    }
}

int main()
{
    // Define the metro system as an adjacency matrix
    int graph[NUM_STATIONS][NUM_STATIONS] = {
        {0, 7, 0, 0, 0, 10, 0, 0, 0, 0},
        {7, 0, 3, 0, 0, 0, 8, 0, 0, 0},
        {0, 3, 0, 4, 0, 0, 0, 6, 0, 0},
        {0, 0, 4, 0, 5, 0, 0, 0, 9, 0},
        {0, 0, 0, 5, 0, 2, 0, 0, 0, 4},
        {10, 0, 0, 0, 2, 0, 0, 0, 0, 0},
        {0, 8, 0, 0, 0, 0, 0, 5, 0, 0},
        {0, 0, 6, 0, 0, 0, 5, 0, 2, 0},
        {0, 0, 0, 9, 0, 0, 0, 2, 0, 3},
        {0, 0, 0, 0, 4, 0, 0, 0, 3, 0}
    };

    // Define the names of the stations
    char* station_names[NUM_STATIONS] = {"RajivChowk", "PatelNagar", "Saket",
"Vaishali", "INA", "JorBagh", "Ghitorni", "KashmiriGate", "QutubMinar",
"NoidaSector-4"};

    char start_name[20];
    char end_name[20];
    printf("Enter the name of the starting station: ");
```

```
    scanf("%s", start_name);
    printf("Enter the name of the ending station: ");
    scanf("%s", end_name);

    int start = -1;
    int end = -1;
    for (int i = 0; i < NUM_STATIONS; i++) {
        if (strcmp(station_names[i], start_name) == 0) {
            start = i;
        }
        if (strcmp(station_names[i], end_name) == 0) {
            end = i;
        }
    }

    if (start == -1 || end == -1) {
        printf("Invalid station name\n");
        return 0;
    }


    // Create an array to store the shortest path from start to each station
    int shortest_path[NUM_STATIONS] = {-1};

    // Find the shortest path using Dijkstra's algorithm
    dijkstra(graph, start, end, shortest_path);

    // Print the shortest path from start to end
    printf("Shortest path from %s Metro Station to %s Metro Station:\n",
station_names[start], station_names[end]);
    if (shortest_path[end] == -1) {
        printf("No path found\n");
    } else {
        int path[NUM_STATIONS];
        int current = end;
        int count = 0;
        while (current != start) {
            path[count] = current;
            current = shortest_path[current];
            count++;
        }
        path[count] = start;
        for (int i = count; i >= 0; i--) {
            printf("%s", station_names[path[i]]);
            if (i > 0) {
```

```
                printf(" -> ");
            }
        }
        printf("\n");
    }

    return 0;
}
```

OUTPUT:

```
Enter the name of the starting station: PatelNagar
Enter the name of the ending station: QutubMinar
Shortest path from PatelNagar Metro Station to QutubMinar Metro Station:
PatelNagar -> Saket -> KashmiriGate -> QutubMinar
```

3. CREATING A DATABASE

```
CREATE TABLE train_location (
    train_id INT PRIMARY KEY,
    latitude DECIMAL(10, 8),
    longitude DECIMAL(11, 8),
    speed DECIMAL(5, 2)
);

CREATE TABLE user_info (
    user_id INT PRIMARY KEY,
    latitude DECIMAL(10, 8),
    longitude DECIMAL(11, 8),
    name VARCHAR(50)
);

CREATE TABLE travel_log (
    user_id INT,
    station_name VARCHAR(50),
    FOREIGN KEY (user_id) REFERENCES user_info(user_id)
);

CREATE TABLE metro_stations (
    station_id INT PRIMARY KEY,
    station_name VARCHAR(50),
    latitude DECIMAL(10, 8),
    longitude DECIMAL(11, 8)
```

```
);

INSERT INTO metro_stations (station_id, station_name, latitude, longitude) VALUES
(1, 'RajivChowk', 28.633912, 77.218434),
(2, 'PatelNagar', 28.654081, 77.173192),
(3, 'Saket', 28.524578, 77.213074),
(4, 'Vaishali', 28.641425, 77.334932),
(5, 'INA', 28.575073, 77.206808),
(6, 'JorBagh', 28.584210, 77.207007),
(7, 'Ghitorni', 28.490920, 77.140932),
(8, 'KashmiriGate', 28.667856, 77.230715),
(9, 'QutubMinar', 28.501325, 77.186950),
(10, 'NoidaSector-4', 28.573128, 77.323790);

INSERT INTO user_info (user_id, latitude, longitude, name) VALUES (1, 28.633912,
77.218434, 'Navdeep Singh Jakhar');

INSERT INTO train_location (train_id, latitude, longitude, speed) VALUES (1001,
28.6139, 77.2090, 50);

INSERT INTO travel_log (user_id, station_name) VALUES (1, 'RajivChowk');
```

OUTPUT:

Metro_stations

station_id	station_name	latitude	longitude
1	RajivChowk	28.633912	77.218434
2	PatelNagar	28.654081	77.173192
3	Saket	28.524578	77.213074
4	Vaishali	28.641425	77.334932
5	INA	28.575073	77.206808
6	JorBagh	28.58421	77.207007
7	Ghitorni	28.49092	77.140932
8	KashmiriGate	28.667856	77.230715
9	QutubMinar	28.501325	77.18695
10	NoidaSector-4	28.573128	77.32379

Train_location

train_id	latitude	longitude	speed
1001	28.6139	77.209	50

Travel_log

user_id	station_name
1	RajivChowk

User_info

user_id	latitude	longitude	name
1	28.633912	77.218434	Navdeep Singh Jakhar

Result:

Thus, the details of architectural design/framework/implementation along with the screenshots were provided.

CONCLUSION

The live tracking system for DMRC metro using IoT has the potential to revolutionize the way metro networks are operated and managed. This technology utilizes a network of sensors, cameras, and other IoT devices to collect real-time data on various aspects of the metro network, such as train schedules, passenger traffic, station occupancy, and train speeds. This data is then processed and analyzed using advanced algorithms to provide accurate and timely information to passengers and metro officials.

One of the key benefits of this system is that it can provide passengers with up-to-date information on train timings, delays, and cancellations. This can help passengers plan their journeys more efficiently and avoid long waiting times at stations. Additionally, the system can also provide information on the current location of the train, which can be particularly useful for passengers who need to make quick connections or transfer to another line.

Overall, the use of an IoT-based live tracking system for DMRC metro has the potential to greatly enhance the passenger experience and improve the efficiency and safety of the metro network. By providing real-time data and insights, this technology can help passengers plan their journeys more efficiently and metro officials to better manage the network. With continued advancements in IoT technology, we can expect to see even more innovative and impactful applications in the transportation industry in the years to come.

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