QR Scan Based Intelligence System for School Bus Tracking

Prof. S. K. Thakare[1], Pankaj Borse[2], Rushabh Kolhe[3], Saloni Deshmukh[4], Sakshi Pawar[5]

Guide, Department of Computer Science[1]
Students, Department of Computer Science[2,3,4,5]
Pune Vidyarthi Griha's College of Engineering & S. S. Dhamankar Institute of Management, Nashik, India

Abstract: *The use of private vehicles intensifies the existing unbearable traffic jam and majority of the parents consider school buses to be largely unsafe for their kids. However, safe and user-friendly school buses can reduce the use of private vehicles and will eventually cut back the traffic jam in cities especially in school hours. All buses can be tracked by the guardians using the proposed intelligent and secured tracking system for school buses. This proposed system includes an Android application that can be employed to send notifications during entry and exit of the students using Barcode scanner, ensuring arrival confirmation of the student by dual authentication. The focus of the research is to display the feasibility of a safe and intelligent school bus using secured tracking system based on authentication procedures. It is expected that the offshoot of this research initiative will regain the confidence and reliability of parents in school bus and reduce the use of individual transport. A smart school bus will keep the student safe, easing the tension for parents and the city will have a smooth traffic system.*

Keywords: School Bus, GPS, QR Scan, Smartphone Application, Android Google Maps API.

I. INTRODUCTION

In this we are going elaborate introduction of the proposed system. This chapter includes overview of the system, motivation and objective of the system. This chapter also explain the how the report is organized.

1.1 Overview

In the context of daily affairs, one of the common problem traffic jam where the personal cars carrying students during school hour directly com- pounds the negative impacts on traffic jam. This happens because parents having private transport don't want to take the risk of using public trans-port or traditional school bus for school-going children. While parents who don't own a private transport and use the public ones to carry the children to school, soften stay around the school for the whole of the school-hour du- ration. These parents often have to take number of different routes in route to school and back home. Another probable scenario is that the parents send their children to school alone but they stay tensed as they don't have any regular status updates of their loving ones.

There can also be issues such as the students may not go to school or just simply passing time outside the institution, while their parents having no way to locate the whereabouts of these students. Metro cities see worsening of the traffic situation, particularly in school hours. All the sides agree that a sustainable solution providing proper safety in school buses would be beneficial to parents as well as to the students themselves. It will also reduce traffic jam in school-hours.

1.2 Motivation

- Now a days it's difficult to send students to school in private cars to school due to heavy traffic as well to ensure their reaching to school in time.
- Travelling through School Bus is perfect solution for same.
- But ensuring child's safety on School Bus is another concern for parents.

1.3 Problem Definition & Objective

A. Problem Definition

- In this system, user can easily track the school bus through GPS system.

- An android application is developed to keep track of Bus which travels to and from.
- Working parents have no way of knowing if and when their kids get home.
- QR code Scanner is provided in every bus to ensure the child to reach school safely and back home.

B. Objective
- Smart-phone based solution is the most viable and easiest to use and implement.
- The system avoids the use of expensive or complicated hardware and has an interface that is easy to use.
- To ensure the child reaches the school safely by School Bus.
- To track School Bus anytime anywhere.
- To ensure safety and reliability of the school buses considering the current conditions of crowded cities

1.4 Project Scope
The main scope of this project is to scan the back side of ID Card QR code to ensure the student will come in and out of bus. The System also take the attendance of every student while pick up and drop of student. This system GPS features would be Track the school bus in real time mode. This system is built to be able to update in future. Some of future updates of this system are,
- Cameras of live images.
- Speed alert and Road change alert.
- Route change notification

1.5 Methodologies
A. Waterfall Model
The Waterfall Model was first Process Model to be introduced. It is also referred to as a linear-sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed fully before the next phase can begin. This type of model is basically used for the for the project which is small and there are no uncertain requirements. At the end of each phase, a review takes place to determine if the project is on the right path and whether or not to continue or discard the project. In this model the testing starts only after the development is complete. In waterfall model phases do not overlap.
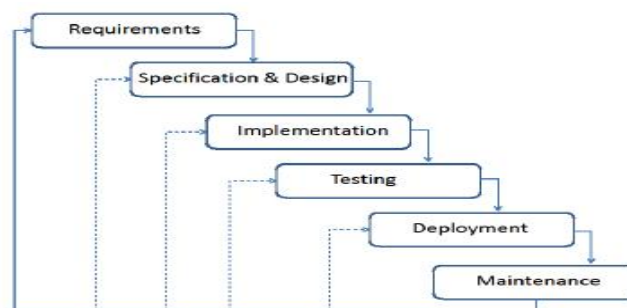

**Figure 1.1:** Waterfall Model

Applications
- This model is simple and easy to understand and use.
- It is easy to manage due to the rigidity of the model - each phase has specific deliverables and a review process.
- In this model phases are processed and completed one at a time. Phases do not overlap.

Architecture
In the system architecture School administration will usually operate the android application under Admin Domain. The user with admin credential has to log in first by a specific username and password. The admin is offered the option of adding and editing students', buses and driver's information. Besides, user authentication and authorization options are

also included in this module. Alongside recently taken actions are shown in the status bar. In this system, QR Code scanning and verification mechanism are attached in the student id card for authentication purpose. There is a display system in the bus to show the matching result.
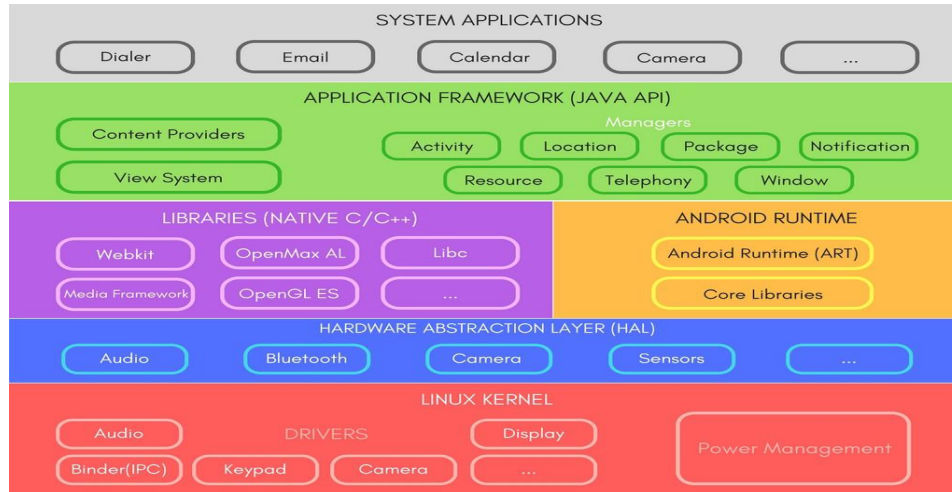
II. LITERATURE SURVEY

2.1 Literature Review

Topic: Smart Tracking System for School Buses

Millions of children require school bus for pick up and drop to the school on an everyday basis. A safe transport for these children is one of the main concerns that need to be taken care of by the school management. Hence, the need for reliable management system of school bus in today's world has increased to a greater extent.

We propose a Smart tracking system for School buses, which is an android based application designed and implemented to provide remote tracking and SMS mode of alert mechanism. The application is user friendly, interactive and secure, which uses Google APIs to fetch the current location and GPS to track the school bus in real time. In order to show the feasibility and effectiveness of the system, this paper presents the methods and workflow of different modules used in the application.

Topic: Bus Tracking System using GPS on Smartphones

The GPS (Global Positioning System) bus tracking system combines the use of automatic vehicle location in individual vehicle with software that collects these fleet data for a comprehensive picture vehicle locations. Bus information can be viewed on electronic maps via the internet or specialized software. Modern bus tracking systems commonly use GPS technology for locating the bus. These systems are particularly using in large cities. This tracking system are commonly used by operators for functions such as tracking, routing, on board information, dispatching and security. These are helpful in daily progresses, such as: traffic congestion, unexpected delays, irregular vehicle dispatching time, other incidents. It provides more convenience with publics and give real time bus.

Topic: Application Based Bus Tracking System

Global positioning system has become an essential part in our day-to-day life, whether it is used for location tracking or to find the nearby taxi. But there is a lack of an application that is more accurate and gives the real-time location of various other transport media like buses. Thus, here we introduce a bus tracking application that can become a high level of penetration in the market. This application can be used as a personal digital assistant. This technique helps people to get the location of the bus via google maps.

This application gives a brief idea about bus location and their provided routes and estimated time to reach the location with online attendance feature and this prototype is totally based on google maps and its API.

Topic: QR Scan Based Intelligent System for School Bus Tracking.

Ensuring safety and security is a major concern and top priority. There have been a lot of reports of mishaps with children during travel. Child safety is always the main concern for parents as well as the school authorities, especially when they are away from their child. They are always eager to ensure that all necessary precautions are being taken.

The literature review comprises of numerous papers of child safety, driver safety, live location and path tracking of buses. The common features across the previous work include location tracking and transmission, unique identification of each child and notifications about the activity to parents.

Architecture Model and Flow Description: The core of this research is to implement an intelligent system for tracking school buses.

- Attendance using QR Code.
- Alerts
- Route Optimization
- Website for school authorities

III. SOFTWARE REQUIREMENT SPECIFICATION

In this chapter we are going to have an overview on- problem system requirements like software requirements, hardware requirements.

3.1 Functional Requirement

3.1.1 Login/Register

This system is well secured and optimized in terms of privacy. This system creates an individual accounts for each user and store their data in the database (My SQL), this data in students and drivers personal data like "Name of students", "Parents Details", "contact details", "Address", " And "Name of driver" , "Contact number", "User Name & Password". This data is secure and is only accessible by the end user. No other person can access this data. The user can also see their previous data in their respective account.

3.1.2 Registration

In this section admin provides full authority. Admin can register data on students data and conductor data create that. When admin registration process complete then QR are generation.

3.1.3 QR Scan

In QR code are generated for students in back side of the ID card attached them.

3.1.4 Conductor login

A admin can provide the username and password share the conductor while creating the data. Conductor are QR code scan that time in option to when entering the school bus then next step to message goes through the parents. Pick up and drop that time send the message cellular phone/what's app message.

Functional user requirements may be high-level statements of what the system should do but functional system requirements should also describe clearly about the system services in detail. The following are the key fields, which should be part of the functional requirements:

- User: Execute the task
- Usability: This relates to how easily people can use your app. A measure of usability could be the time it takes for end users to become familiar with your app's functions, without training or help.
- Reliability: This is the percentage of time that your app works correctly to deliver the desired results, despite potential failures in its environment.
- Performance: This is essentially how fast your app works. A performance requirement for the app could be start in less than 20 seconds.
- Responsiveness: This requirement ensures that your app is ready to respond to a user's input or an external event no matter what it's doing currently.

3.2 External Infrastructure
3.2.1 Hardware Infrastructure
Basically don't use any external device i.e Camera. In feature are use external QR scanner for scanning purpose are used.

3.3 Nonfunctional Requirements
3.3.1 Performance Requirement
GPS Location and internet connection will on the system for proper used.

3.3.2 Safety Requirements
The database may get crashed at any certain time due to virus or operating system failure. Therefore, it is required to take the database backup.

3.3.3 Security Requirement
Every user has to create a personal account to use this system. The registered users can directly login to the system, with their login credentials. Every new user has to register themselves in the system. The registering process requires users Name, Age, Gender.

Occupation and password, all this user details are stored in a secure database. The user can also view their personal data on their respective account.

The security of this system is very good. To create an account the user has to set a username and password while registering their account. The username selection criteria are that there should only be alphabets and numbers present in the username, and in the password, user can choose to have alphabets, number and special characters. Each username and password should be unique to maintain the user credential security.

3.4 System Requirement
3.4.1 Database Requirement
A. My SQL
My SQL is an open-source document database and leading My SQL database. My SQL is written in C & C++. This tutorial will give you great understanding on My SQL concepts needed to create and deploy a highly scalable and performance-oriented database. For system we have used My SQL as the database storage medium. This database stores the user's login credentials, personal data and previous mood history of the user.

3.4.2 Hardware Requirements
- OS: windows 7 Above
- Processor: Pentium Processor core 2 Duo or Higher
- Memory: 4 GB
- Android Mobile with their Camera
- QR Scanner or Android mobile camera.
- GPS

3.4.3 Software Requirements
- IDE (Integrated Development Environment): Android SDK.
- Java : Jdk 8.0 or above.
- My SQL For Database

IV. SYSTEM DESIGN
In the system architecture School administration will usually operate the website, under Admin Domain. The user with admin credential has to log in first by a specific username and password. The admin is offered the option of adding and editing students', buses and driver's information. Besides, user authentication and authorization options are also included in this module. Alongside recently taken actions are shown in the status bar.

In this system, QR Code scanning and verification mechanism are attached in the student id card for authentication purpose. There is a display system in the bus to show the matching result. GPS is also implemented in the bus for real time navigation. All these devices are connected with a microcontroller which uses esp8266WIFI module to send the data in the database. The overall architecture has been shown

4.1 System Architecture

A system architecture or systems architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that sup- ports reasoning about the structures and behaviors of the system. A system architecture can consist of system components and the subsystems developed, that will work together to implement the overall system. There have been efforts to formalize languages to describe system architecture, collectively these are called architecture description languages (ADLs).
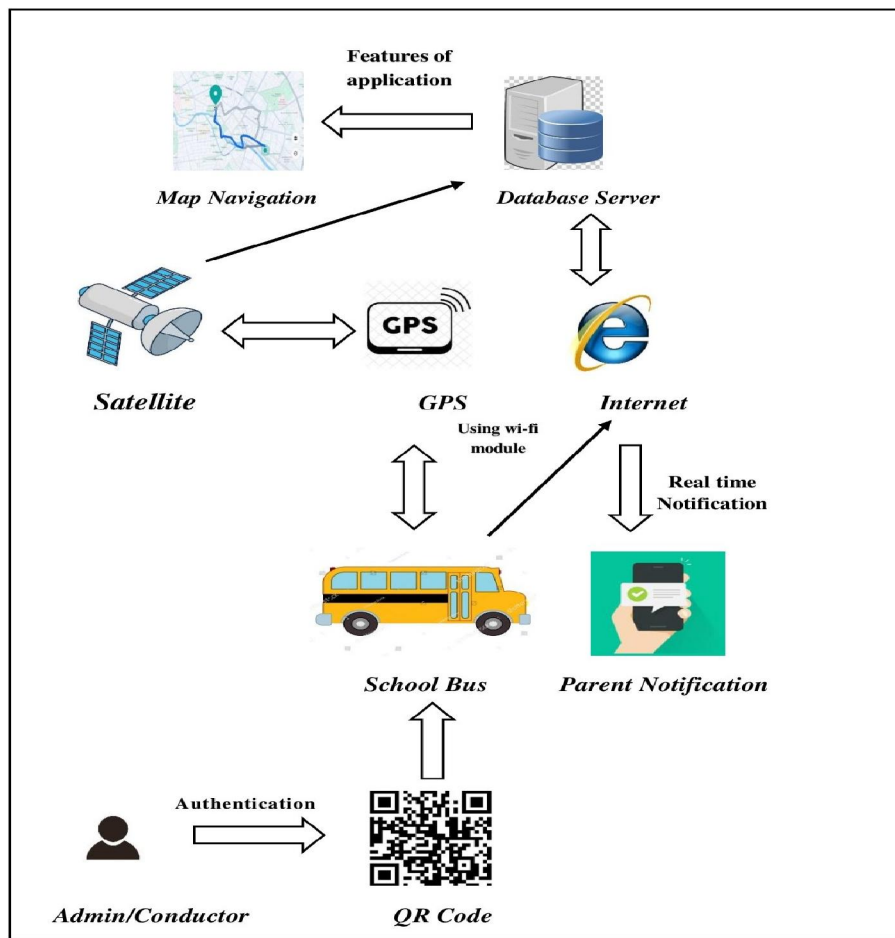
Figure 4.1 System Architecture for QR scan based intelligence system for school bus tracking

4.2 UML Diagrams

This Section content nine UML Diagram, which clearly specify the exact functionality of the prototype and they are as follows,

1. DFD Level 2
2. Class Diagram
3. Use case Diagram

4. Activity Diagram
5. Sequence Diagram
6. Component Diagram
7. Deployment Diagram

4.2.1 DFD Level 1 Diagram

A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system, modeling its process aspects. A DFD is often used as a preliminary step to create an overview of the system, which can later be elaborated. DFDs can also be used for the visualization of data processing.

The below diagram shows the basic work flow of the system. The initial process starts with the user. The user first step for the user is to login/register into the system. While registering the user has to enter multiple data's that are users Name, Age, Password, Gender and Occupation. This login credential of the user will get stored in the database; the system will further access the data search for the respective user when logging in.
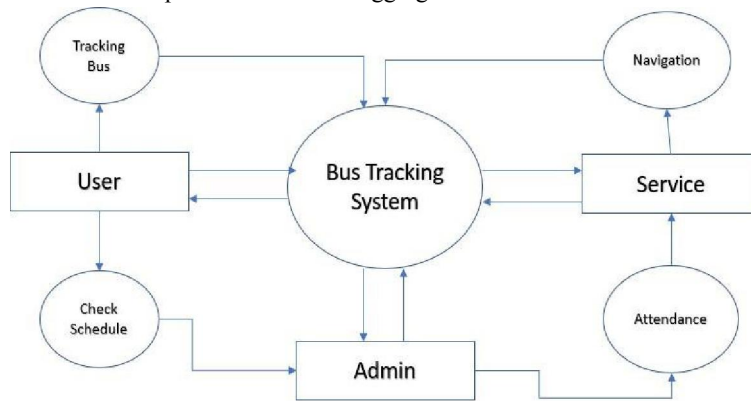
Figure 4.2: DFD Diagram

4.2.2 Class Diagram

Class diagram represents the static view of application and it shows a collection of classes, interfaces, associations, collaborations, and constraints. In this diagram different classes shows interfacing of different modules.
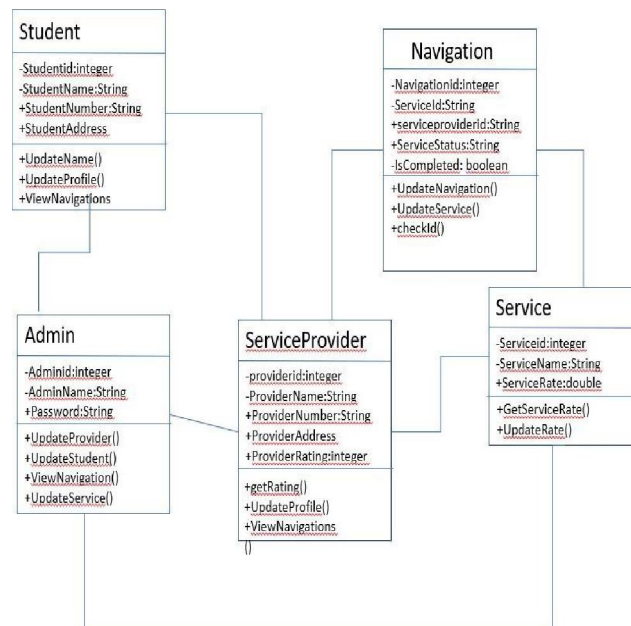
Figure 4.3: Class Diagram

4.2.3 Use Case Diagram

Use Case Diagram. Example is given below It shows a set of use cases and actors (a special kind of class and their relationship). Use case diagrams address the static use case view of system. These diagrams are especially important in organizing and modeling the behavior of a system.
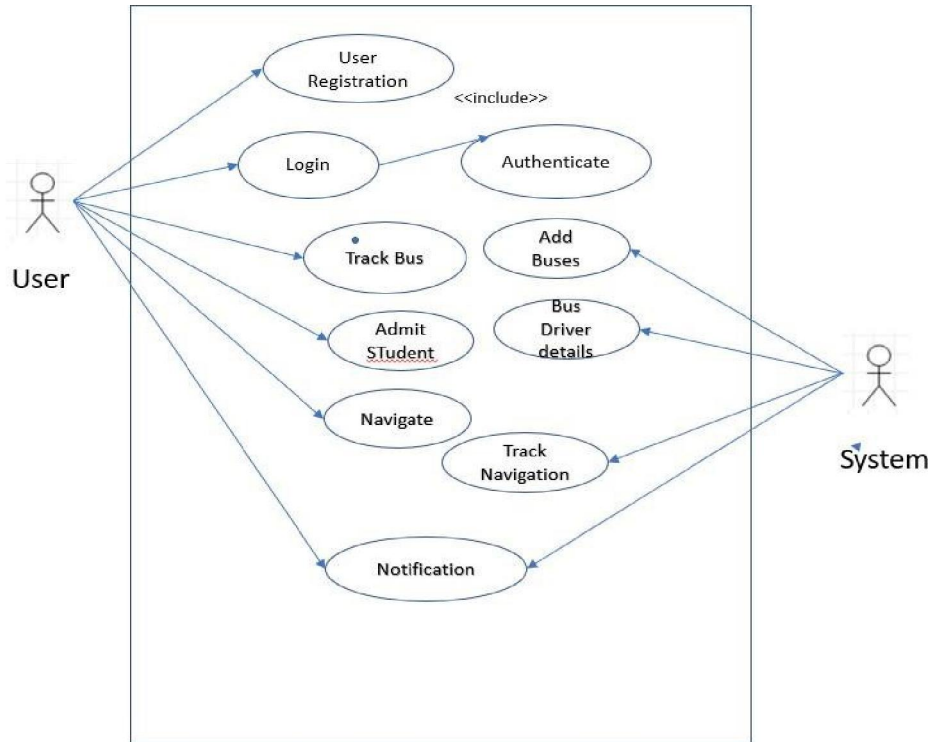

Figure 4.4: Use Case Diagram

4.2.4 Activity Diagram

Activity diagram focuses on flow of control from activity to activity. It shows work flow of our model. Below figure shows activity states, transitions, loops, decision nodes and concurrent activities use by our proposed system.
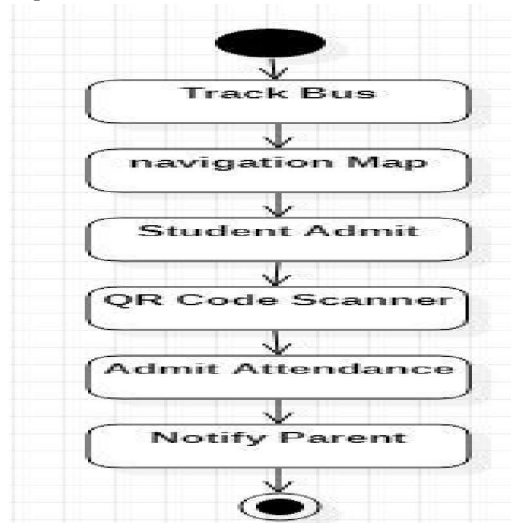
Figure 4.5: Activity Diagram

4.2.5 Sequence Diagram

Sequence diagrams provide a graphical representation of object interactions over time. These typically show a user or actor, and the objects and components they interact with in the execution of a use case. One sequence diagram typically represents a single Use Case 'scenario' or own of events. Sequence diagrams are an excellent way of documenting usage scenarios and both capturing required objects early in analysis and verifying object use later in design. The diagrams show the own of messages from one object to another, and as such correspond to the methods and events supported by a class/object.
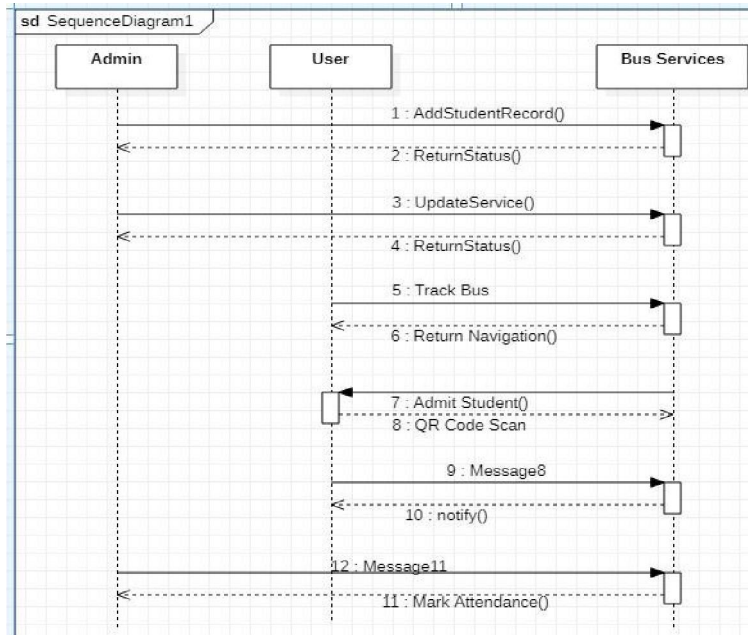
Figure 4.6: Sequence Diagram

4.2.6 Deployment Diagram

In Deployment diagram there are four nodes namely server, client, prototype, and database. All the clients are connected to the database. This deployment diagram shows the hardware requirement of the prototype. How this prototype is working with hardware is the main logic behind the deployment diagram.
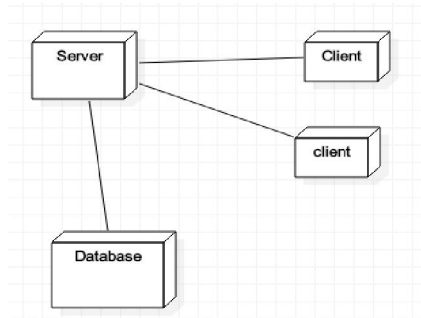
Figure 4.7: Deployment Diagram

V. PROJECT PLAN

In this chapter we are going to have an overview about how much time does it took to complete each task like Preliminary Survey Introduction and Problem Statement, Literature Survey, Project Statement, Software Requirement and Specification, System Design, Partial Report Submission, Architecture Design, Implementation, Deployment, Testing, Paper Publish, Report Submission and etcetera.

This chapter also gives focus on stakeholder list which gives information about project type, customer of the proposed system, user and project member who developed the system.

5.1 Team Organization
The Stakeholder list shows the persons who are interacting with the prototype in various roles.

Sr. No.	Stakeholders	Any User of Online Social Network
1	Project Type	Innovative Work
2	Customer	Used for any Schools or Collages.
3	User	Any Organization
4	Project Team Members	Pankaj Ishwar Borase.
		Rushabh Babasaheb kolhe.
		Saloni Satish Deshmukh.
		Sakshi Shamrao Pawar.

Table 5.1: Team Organization

5.2 Project Estimate
The System Implementation plan table, shows the overall schedule of tasks completion and time duration required for each task.

Sr. No.	Task	Start Date	End Date
1.	Primary Survey	02/08/2021	03/08/2021
2.	Introduction and Problem Statement	06/08/2021	10/08/2021
3.	Literature Survey	13/08/2021	25/08/2021
4.	Project Statement	28/08/2021	30/08/2021
5.	Software Requirement and Specification	31/08/2021	02/09/2021
6.	System Design	04/09/2021	07/09/2021
7.	Partial Report Submission	30/09/2021	10/12/2021
8.	Architecture Design	20/12/2021	27/12/2021
9.	Implementation	20/12/2021	28/12/2021
10.	Deployment	03/03/2022	09/03/2022
11.	Testing	10/03/2022	15/03/2022
12.	Paper Publish	25/03/2022	12/04/2022
13.	Report Submission	25/04/2022	-

Table 5.2: System Implementation Plan

5.3 Timeline Chart
The Timeline Chart of the system shows the schedule and coordinated tasks with in the project implementation span.
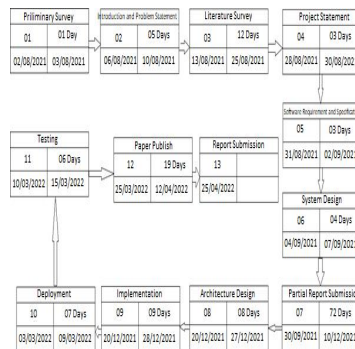

Figure 5.1 Timeline chart

VI. SYSTEM IMPLEMENTATION

6.1 Overview of Project Model

A. Proposed Work

- Step 1: At first student's QR Code will be Scanned for the first level verification.
- Step 2: If the Barcode doesn't match, then it will be considered as invalid attempt.
- Step 3: Verification is done
- Step 4: If a positive match occurs, data will be sent to database and parents will be notified about the student's arrival.
- Step 5: When the student is about to be dropped off to his or her destination point code is checked again.
- Step 6: Then notification will be sent to parents; so that student can't get out of bus anywhere else or can't be late to get out of the bus when they reach at school.

6.1.1 Student Registration

In this system admin can accessed to all authority. It will be interact means registration of the students. Admin can add and update the student information to the database. The updated information will be reflected in the android application itself.

6.1.2 Driver Registration

- Admin can add and update the driver information to the database.
- Driver can continue on their mobile or bus GPS.

6.1.3 QR Code Scan

Bus driver getting student ID card of back side QR code scan. Then automatically generate the student attendance and then send SMS notification of their parents.

6.1.4 Notification Generation

- In driver scanning their QR and it will be generate the notification send.
- Parents to get drop and pickup notifications of their children.

6.1.5 Location

- Location of the user is traced.
- The location is sent in SMS in URL form. The URL is directed to G-Map.
- Exact location is detected easily.

6.2 Algorithm Details

A. Algorithm Details

AES stands for Advanced Encryption Standard and is a majorly used symmetric encryption algorithm. It is mainly used for encryption and protection of electronic data. It was used as the replacement of DES (Data encryption standard) as it is much faster and better than DES.

AES consists of three block ciphers and these ciphers are used to provide encryption of data. The block to be encrypted is just a sequence of 128 bits. AES works with byte quantities so we first convert the 128 bits into 16 bytes. We say "convert," but, in reality, it is almost certainly stored this way already. Operations in RSN/AES are performed on a two-dimensional byte array of four rows and four columns. These steps involve four types of operations called:

- Byte substitution
- Shift rows
- Mix columns
- Add round key

AES Algorithm are used in password encryption login modules.

Steps for AES Algorithm:

1. Derive the set of round keys from the cipher key.
2. Initialize the state array with the block data (plaintext).
3. Add the initial round key to the starting state array.
4. Perform nine rounds of state manipulation.
5. Perform the tenth and final round of state manipulation.

Copy the final state array out as the encrypted data (cipher text).

VII. SOFTWARE TESTING

In this chapter there is relevant explanation on testing strategies use to test the system, and test cases.

7.1 Types of Testing

Testing Strategy used for testing the system are as follows,

1. Unit Testing
2. Integration Testing
3. Regression Testing

7.1.1 Unit Testing

In case of unit testing, each software component, software modules or software subsystem is tested independent of any other components involved in the whole software system.

This is individual software modules or software components are tested in unit testing. The main agenda behind unit testing is to verify and validate each and every unit of the software system by checking its working and performance and comparing it with the software specification. The significant control paths are tested and verified to discover errors within the boundary of the module and the component level design used for the same.

7.1.2 Integration Testing

Integration testing is a kind of testing meant for building the software architecture along with finding out the errors related with the interfacing. After successful execution of unit testing, software subsystem will be collected together and combined together in order to build the whole software system as it is specified and define at high level design.

Integration testing is an efficient procedure for verification of the structure of a software system and validation of order of execution of software system while conducting tests to determine errors allied with interfacing.

7.1.3 Regression Testing

During the software development procedure, whenever the software system is modified by means of editing, removing, adding source code, software developers need to be sure that the new version of the software is good as earlier version. Tests that focus on the software modules that have been modified or altered and focus on overall functionality of the software system when the software functions are likely to be affected by the modifications or change.

7.2 Test Cases & Test Results

Test cases are written for four module and they are as follows,

1. Login Module for Admin & Driver.
2. Registration of student.
3. Registration of driver.
4. Log Out Module

7.2.1 Login Module

Sr. No.	Test Type	Test Scenario	Precondition	Test Case Steps	Expected Result	Result
1	GUI	Verify GUI Page the Login	Launch application and open URL	1.check the spelling font, alignment, color 2.Check overall look and feel of the page.	Login Page should Maintain consistency	Pass
2	Positive	Verify the User Login with valid credential	Open the URL	Enter Valid User Name and Password credentials in their respective fields. 2. Click on Login button.	Page should navigate to the user home page	Pass
3	Positive	Verify the Admin Login with ValidCredentials	Open the URL	1. Enter Valid Admin Name and Password credentials in their respective fields. 2. Click on Login button.	Page should n a v i g a t e to the adminhome page.	Pass
4	Positive	Verify the Admin Login with ValidCredentials	Open the URL	1. Enter Valid Admin Name and Password credentials in their respective fields. 2. Click on Login button.	Page should n a v i gate to the adminhome page.	Pass
5	Positive	Verify the User Login with invalid credentials	Open the URL	Enter invalid lo-gin credentials	Page should not navigate to user home page and it should display the validation message.	Pass
6	Positive	Verify the Admin Login with invalid credentials	Open the URL	Enter invalid login credentials Username or Password	Page should not navigate to admin home page and it should display the validation message.	Pass
7	Positive	Verify the functionality of the user login page	Open the URL	1. Click on login Link. 2. Enter all the mandatory fields 3. Click on" Login"	Page should navigate to the user home page	Pass

Table 7.4: Test Cases for Login Module

7.2.2 Log Out Module

Sr.No	Test Type	Test Scenario	precondition	Test Case Steps	Expected Result	Result
1	Positive	Verify the Lo-gout link.	Click on lo-gout link	Click on logout link.	Page should n a v i gate to the homepage.	Pass
2	Positive	Verify the functionality of logout link.	Click on lo-gout link.	Click on logout link.	Page should n a v i gate to the homepage.	Pass

Table 7.7: Test Cases Log Out

7.3 Test Report

Module Name	Test Engineer Name	No of Test Cases Pass	No of Test Cases Fail	Total No of Test Cases
Log In	Miss. Sakshi Pawar	7	0	7
Upload on server (Frontend)	Mr. Rushabh Kolhe	5	0	5
Upload on server (Backend)	Mr. Pankaj Borase	5	0	5
Log Out	Miss. Saloni Deshmukh	2	0	2

Table 7.8: Test Report

VIII. RESULTS

8.1 Screenshots
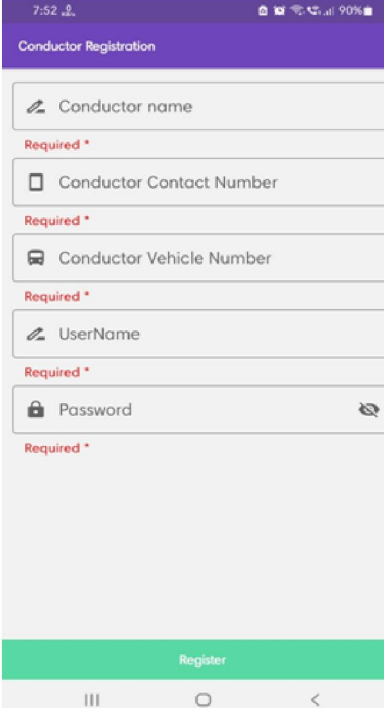
A. Admin/Conductor:
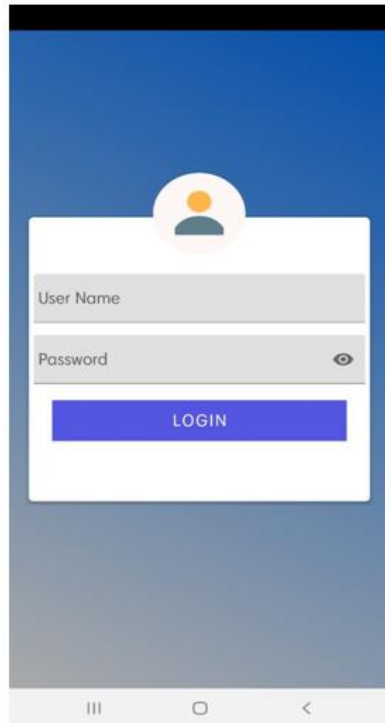
Admin/Conductor Credential   Admin Dashboard

Conductors Registration
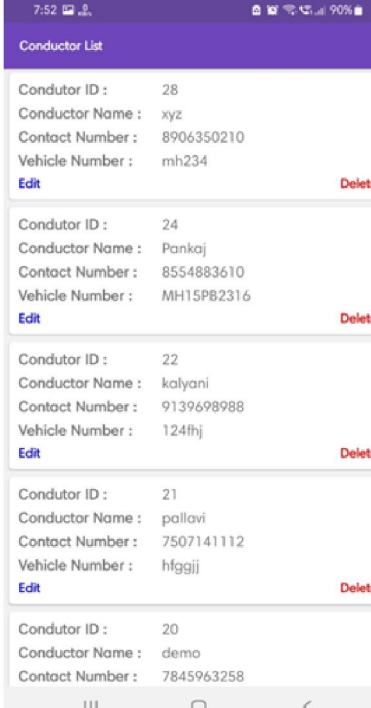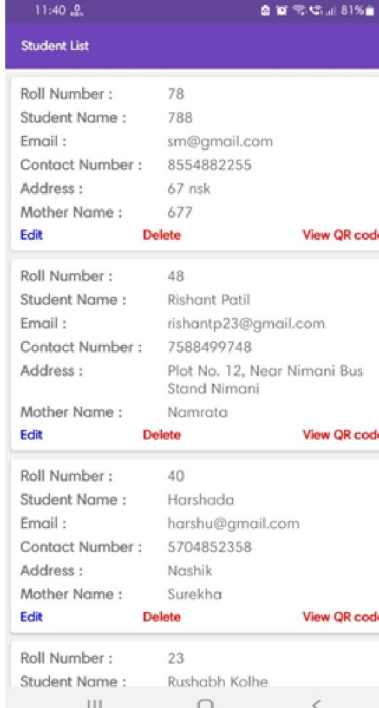
Students Registration

Conductor List

Students List

Impact Factor: 6.252
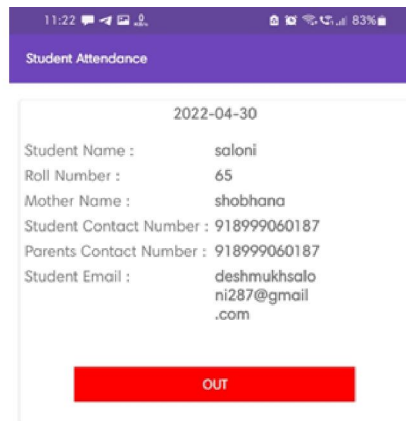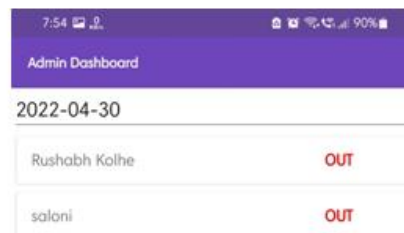

Generated QR Code
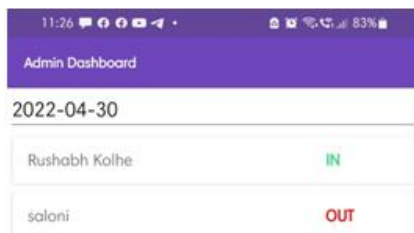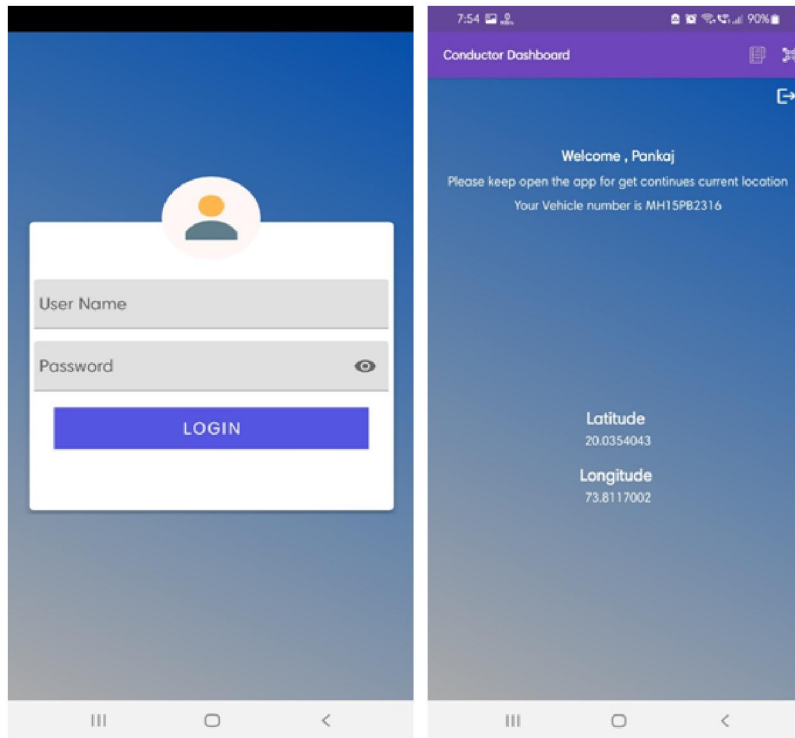

Scanner
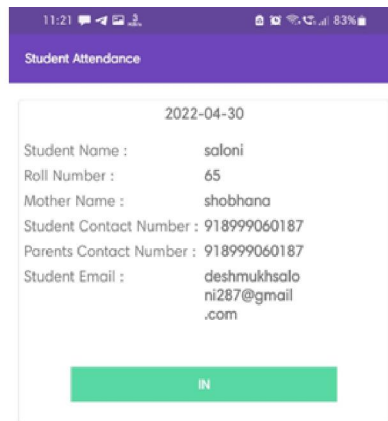
Pick-up (option IN)
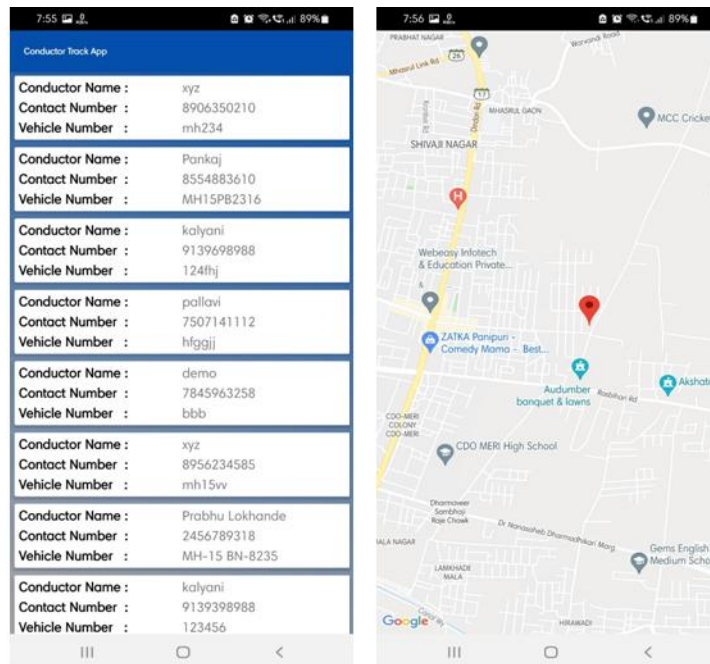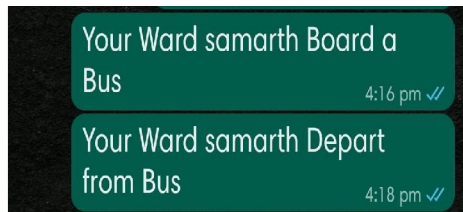

Drop-out (option OUT)

Students Attendance Data

Conductor Credential & Dashboard

Conductor List   Location of Conductor

Message Notification To Parents

IX. CONCLUSION

In this study, a secure school bus system has been proposed for city. This system will ensure safety; ease tension and anxiety of parents, and will without doubt, improve road conditions. It will also provide an easy pick1up system by providing notifications. Guardians will get notifications through an Android application; this app can be used to see the current status of the bus through map; thus, it will be easy for the parents to track the movement of the bus and get notified at the appropriate times. Hence, they will have a highly reliable, secure and intelligent system to depend upon.

9.1 Future Work

In future system include plan to install for IP cameras which will pro- duce live images from inside the bus, it will also add speed alert, road change alert, route change notification, smoke sensor, addition of stop- page ID in the entry and exit notification etc. An efficient encryption method will be developed to strengthen security.

1. Speed alert
2. Road changes alert
3. Route changes notification
4. Smoke sensor
5. Addition stop-page ID

9.2 Applications
A. Transportation

In the transportation and logistics business, GPS or GPS technology today extends further than just a tool to help drivers to navigate from locations. With the advancement in mobile technology and mobile apps for logistics mobility solutions. GPS technology has fully transformed the transportation industry. They are mobile app developers that can hand you advanced GPS vehicle tracking systems that include business-effectual tools required by your business and customer needs. Few Benefits in GPS Tracking system in transportation:

1. Healthcare Transportation
2. Driver And safety performance
3. Unmatched efficiency
4. Reduce administrative resources
- It is easy to manage due to the rigidity of the model - each phase has specific deliverables and a review process.
- In this model phases are processed and completed one at a time. Phases do not overlap.
- Waterfall model works well for smaller projects where requirements are very well understood

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