

# UNIVERSITY OF DAR ES SALAAM



## COLLEGE OF INFORMATION AND COMMUNICATION TECHNOLOGIES

### DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

#### IS335 / CS498: Final Year Project Report – End of Semester One

**Project Title:** SCHOOL BUS TRACKING MANAGEMENT SYSTEM.

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## DECLARATION

I certify this report and the work it describes are my original creations, with any explicit acknowledgment or citation of the contributions of others.

I further declare that the work contained in this report was completed in accordance with University of Dar es Salaam regulations and that it was not sent to another university for review, either in Tanzania or abroad. The report's opinions are entirely mine and do not in any ways reflect those of the University of Dar es Salaam

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## **ABSTRACT**

This paper presents a system to monitor the pick-up/drop-off school children to enhance the safety of children during the daily transportation from and to school. It intends to reduce the waiting time of parents and their children waiting for school bus, thereby to stimulate the sharing of real time information about the bus between the bus driver and parent.

The system will be a mobile based and web based application. The mobile version of the system will be used by the parents and drivers, while the web version of the system will be used by the school admin.

This paper consists of four chapters, introduction, literature review, methodology, system analysis and design. The general methodology used in this project is waterfall methodology and for data collection unstructured interviews was used.

## **ACKNOWLEDGEMENT**

Since authoring this work has not been simple, I would like to take this opportunity to express my gratitude to the Almighty God.

Additionally, we would like to express our sincere gratitude to our supervisor, Mr. MARCO MASEMBO, who worked tirelessly with us to guide and direct us in the proper course of action. And all of that has been sufficient, for which I am sincerely grateful.

Additionally, I want to thank Dr. Joseph Cosmas, the coordinator of our senior project, for his support and involvement in the writing of this report. Along with that, I'd like to express my gratitude to the University of Dar es Salaam's administration and the College of Information and Communication Technology (CoICT). That gave us the opportunity to complete this project, which will be extremely helpful to us as University of Dar es Salaam students. I'm very happy about that.

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### **LIST OF ABBRIVIATION.**

API	Application Programming Interface
COICT	College of information and communication technology.
DBMS	Database Management System
GPS	Global positioning system.
SDLC	System development life cycle
UDSM	University of Dar es Salaam

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## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 General introduction.**

When it comes to the issue of transportation, time and patience are more essential. In other words many people especially those who use the public transport buses have experienced time loss because of various delays that happen. Millions of children need to travel from home to school every day. Thus most parents are striving to get a safe transport for their children because there have been an increase in crimes against children.

The safety of children has become a major concern for many parents in recent years, most parents are working this becomes a challenge to take their children to school and later to bring them home. Here the bus transport provided by the school comes into picture, but due to safety reasons, this has caused them to worry much about their children's safety on school buses. They are constantly concerned about the arrival time of their children's bus for pick-up and drop-off. Have children boarded the bus? Where is the bus taking their kids? Is the arrival of the kids delayed in any way?

The increased use of school buses has posed a great pressure to the school administration to come up with better ways to manage students when they use school transport. Since these school buses are used by students of very young age, there might be some risks that may happen having no one to blame.

In some situations, school managers employ new drivers who are not familiar with the students' pick-up and drop-off points thus they end up dropping students at points which are far from their homes or even going to routes that they were not supposed to go causing huge fuel consumption.

## **1.2 Statement of the Problem**

The school buses take long to arrive a students' pick-up point causing parents to wait longer with their kids but this situation may be caused by various reasons such as break-down of the school bus or sometimes may be due to new drivers who are not familiar with the routes. Sometimes the delay can be caused by parents' negligence to reach at pickup point in right time, this can lead driver to wait for them and delay to reach to the pick up points of other students in right time.

## **1.3 Objective**

### **1.3.1 Main Objective.**

To develop School Bus Tracking Management System which will Keep parents directly informed and notified easy about the movements of their children from home to schools and way back home, whilst allowing schools to manage and control emergency situations efficiently. Allow a driver to privately notify school administrator of emergency events directly through customized push notifications such as car breakdown emergency.

### **1.3.2 Specific Objectives.**

- i. To conduct a survey to identify the need for School Bus Tracking Management System.
- ii. To establish requirements for the School Bus Tracking Management System from stake holders
- iii. To design School Bus Tracking Management System from the gathered requirements.
- iv. To implement the design of the system

#### **1.4 Significance of the project**

- i. The system helps to reduce the waiting time of parents and students waiting for the school bus.
- ii. The system helps the school administration to keep track and monitor the route of the school buses
- iii. The system acts as a directive to new drivers to know pickup points of the students
- iv. The system gives notification to the parents and school administration about any emergency that has occurred.

#### **1.5 Project scope**

The scope of this project is based on nursery and primary school students, parents, school administration and school bus drivers in tracking the school buses and getting real-time information about them. The administrator module is concerned with all administration details, The parent module is concerned with the management of the student details in regards to the school bus assigned to his child, while the driver module is based on the details regarding the real-time information about the vehicle. The system database will capture the school Admin details, student details, parents details driver details, routes' details, pickup points of students and the vehicle details.

## 1.6 Organization of the project

Table 1.1: Organization of Report the Project

Number	Content
1	Cover page
2	Table of contents
3	List of abbreviations and figures
4	Chapter one: Provides a deep introduction about the project by explaining what is about to be done and what are the steps and procedures to be followed so as to implement the project successfully.
5	Chapter two: Provides literature review details, gives the overview of the given topic by considering other related publications regarding that topic.
6	Chapter three: Provides project methodology, where in this chapter the methodology that has been used to implement the project has been discussed in depth by describing it, its significance and the phases associated with it at large.
7	Chapter four: Provides System designs and analysis, where it shows methods used to gather requirements, core functionalities of the system. Requirement analysis which explains about functional and non-functional requirements. Also, it contains system design phase which consist of system architecture design, sequence diagram and entity relation diagram.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Overview**

A literature review involves the process of survey of the major writings and other sources that provides an overview of a selected topic. This chapter consists of different reviews on the concept of this project topic.

#### **2.2. Existing solutions**

##### **2.2.1 Bustracker**

Bustracker is a mobile and web-based application which focuses on providing parents/guardians with information about the school buses boarded by their children. The literature review was undertaken how this system works. This system helps to track school buses from the parent's mobile phones and receive all real-time information about the school bus, it also offers additional functionalities such as emergency management, and push notifications.

( <https://bustracker.co.tz/> )

##### **2.2.2 Schoolbus**

Schoolbus is a mobile based application where parents and guardians track their children's school buses via SMS and Mobile application. This application has two modules which are driver module and the parent module, it mainly facilitates the communication between the parent and the bus driver. (<https://multics.co.tz/products/schoolbus>)

### **2.3 Project Gap**

Some core and basic functionalities such as GPS tracking of school buses, Vehicle information management, Mobile alerts, Route management that exist in the current systems will be reused and modified in our system.

Our system will also add other functionalities such as student emergency management, Confirm Pick-up and drop-off of students. Improve user experience as some existing systems are not user friendly, by improving user experience it helps to fulfill the user's need in a smooth way.

## CHAPTER THREE

### METHODOLOGY

#### 3.1 Overview

Methodology is a formalized approach to implementing the system development life cycle (SLDC) i.e., is the list of steps and deliverables. In this project the software development methodology that is going to be used is Waterfall Development. (Allan Dennis , Barbara Haley Wixom & David Targarden, 2015)

#### 3.2 Waterfall Development

Waterfall Development is a system development methodology in which analysts and users proceed sequentially from one phase to the next. (See Figure 1) The key deliverables for each phase are typically voluminous (often, hundreds of pages) and are presented to the approval committee and project sponsor for approval as the project moves from phase to phase. Once the work produced in one phase is approved, the phase ends and the next phase begins. As the project progresses from phase to phase, it moves forward in the same manner as a waterfall. While it is possible to go backward through the phases (e.g., from design back to analysis), it is quite difficult. (Allan Dennis , Barbara Haley Wixom & David Targarden, 2015)

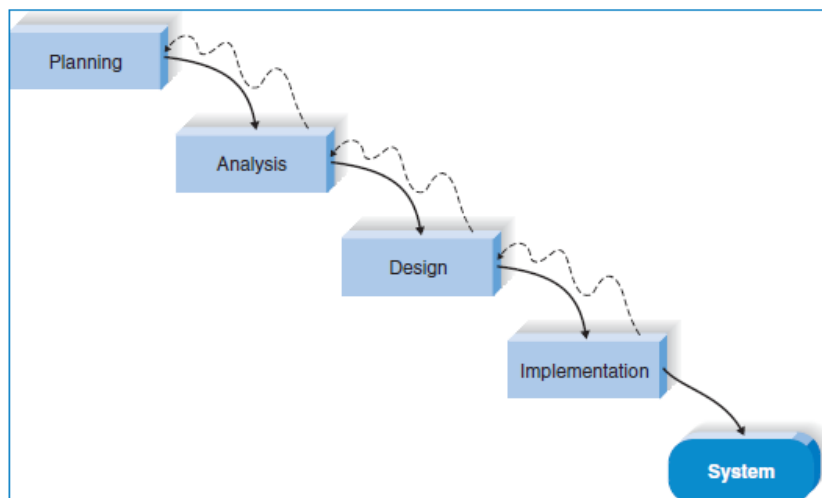


Figure 3.1: Methodology Model

### **3.3 Significance of Waterfall Development**

Waterfall development methodologies have the advantages of identifying requirements long before programming begins this will help to clear understanding of requirements of clients, limiting changes to the requirements as the project proceeds.

Furthermore, in waterfall methodology the process phases distinction is clear since the process proceeds sequentially from one phase to the next. Once the work produced in one phase is approved, the phase ends and the next phase begins no interaction between phases.

### **3.4 Stages of Waterfall Development**

The following tasks are going to be accomplished throughout SDLC of the project;

Waterfall Development breaks the product into small incremental builds.

#### **3.4.1 Requirements gathering and Analysis**

We will establish requirements from experts and the stakeholders such as parents, school administration and drivers. The requirements will be gathered through interviews (open ended questions).

In interviews we will organize some interviews with some parents, school heads and drivers.

This method can be used accordingly depending on the type of project you have and the types of data you want to retrieve.

The team will analyze the data collected during the requirements gathering stage by using object-oriented approach and identify the key challenges and opportunities facing the stakeholders. This will focus on identifying functional requirements of system based on findings from our stakeholders.

In addition to that our team will use those data to brainstorm non-functional requirements of the system since it would be difficult for our stakeholders to talk about them. Also, will generate different solutions.



### **3.4.2 Design**

After clearly understanding the requirements, we will plan how to build requirements into a product. That is creating and designing of the system. Here we will produce design diagrams such as the use case diagram, database design, sequence diagram and architecture design of the system. The use case diagram will include the actors and the functionalities that are triggered by the specific user. The database design will show how the data of the different entities of the system will be organized and how these entities are related to each other. The sequence diagram will show how the process interaction will be arranged in time sequence. Lastly the architecture design will show how the hardware and software components interact and their interfaces. The tools that will be used are Draw.io

### **3.4.3 Development**

In this phase we will implement the design of the system. The implementation of the system will involve linking the GPS tracker with a software part of the system. In software part of the of system we are more likely to use flutter framework for the frontend and Firebase for the backend. Moreover, there will be some APIs that will help us in fetching the data from the GPS tracker as well as the database. For the case of APIs, POSTMAN will be used to test the APIs for the frontend we will use flutter framework to implement the design of the user Interface

Also, in this phase our project will use git as version control for our system.it will help us to keep track of various changes that we will make and also organizing our project and team as well. The code editor we will use is Visual studio, and all of its supported extensions to ensure good quality code.

## **CHAPTER FOUR**

### **SYSTEM ANALYSIS AND DESIGN.**

#### **4.1 Introduction.**

This chapter shows the summary of data collected from stakeholders and analyses the collected data which lead to the development of system's requirements and the overall design of various system parts. It provides complete description of all functionalities and specification of School Bus Tracking Management System

#### **4.2 Requirement gathering**

This stage involves collection of data from our stakeholders i.e., the school Admin, parents and drivers. The techniques used in gathering data were as follows;

##### **4.2.1 Interview**

We prepared open-ended questions that used to interview the school Admin, drivers and parents. From collected data we were able to generate a list of requirements such as functional and non-functional requirements.

The following are interview questions that we used in gathering of requirements of the system from different stakeholders which are parents, School Admin and school bus driver;

School Admin

- How do you manage bus routes and schedules?
- How do you communicate delays and changes in bus routes to parents and guardians?
- How do you ensure that students are dropped off/picked up at their correct points?
- How do you help new drivers to know the pickup points of the students?
- How do you ensure that drivers pass to the allocated route?
- Generally, what are the challenges faced by the school administration in managing school buses?

Drivers

- How do you handle delays caused by parents?
- How do you know the pickup points of the newly admitted students?
- How do you communicate emergencies to parents and guardians?
- As a driver, what challenges do you face?

Parent

- How do you ensure that your kids were picked up and dropped off at the correct point?
- As a parent or guardian what challenges do you face concerning school buses?

#### **4.3 Core functionalities.**

- i. Management of users
- ii. Global position System (GPS) tracking
- iii. Routes Management.
- iv. Emergence Managements.

And the activities under each core functionality are as follows;

- i. Management of users
  - User registration
  - Update users' information
  - Deletes users' information
- ii. Routes Management
  - Registering of buses and assign buses to drivers.
  - Buses route planning.
  - Pick-up and drop-off confirmation for students.
- iii. Global position System (GPS) tracking
  - Get real time information of the bus
  - View bus details
- iv. Emergence managements.
  - Declaration of bus emergence. Example bus breakdown
  - Declaration of student's emergence example sickness of students.

#### 4.3.1 Functional requirements.

These relate directly to the functioning of the system and aspects of the system the client is likely to recognize. Functional Requirements for each core functionality are described in the table below

Table 4.1: Functional Requirement

Ref. No.	FUNCTION DESCRIPTION		CATEGORY
<b>F1</b>	<b>Users Management</b>		
	F1.1	The system should allow users to be registered in the system.	Evident
	F1.2	The system should be able to send notification about Successful registered or not successful registered users.	Evident
	F1.3	The system should authenticate users and redirect them to their specified profiles.	Hidden
	F1.4	The system should allow users to log out from the system	Evident
<b>F2</b>	<b>Routes Management</b>		
	F2.1	System should allow School Admin register buses and assign them to drivers.	Evident
	F2.2	System should allow School Admin to plan bus routes	Evident
	F2.3	System should allow the parents to confirm pick-up and drop-off students.	Evident
<b>F3</b>	<b>Global position System (GPS) tracking</b>		
	F3.1	System should allow user to get real time information of the bus	Evident
<b>F4</b>	<b>Emergence managements.</b>		
	F4.1	System should allow a driver to declare emergence example car breakdown.	Evident

	F4.2	System should allow parent to declare student's emergence	Hidden
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#### 4.3.2 Non-functional requirements

Non-functional requirements are the requirements that specifies how a system performs its operations. These are the constraints by which the system is under, they are the quality or standards that the system should adhere to

summarized in the table below as follows;

Table 4.2: Non-functionalities of the system

Attribute	Constraints
Usability	The system must be easy to use and understand to both Administrator and parents.
Scalability	The system must be able to handle an increase number of users buses and students.
Security requirement	The system must be secure and protect sensitive information such as students' personal details and bus routes.
Compatibility	The system must be compatible with variety of devices include Computers, smart phone and tablets
Maintainability	The system shall be easy to maintain, repair and undergo some improvement since we are localizing the system will be easy to maintain, upgrade and update its functionality so as to improve its efficiency and effectiveness of its functionalities.
Performance	The system must provide real time update about bus location and arrival time and respond quicky to the user request.
Interoperability	The system must be able to integrate with other system.
Reliability	The system must be dependable and consistently and deliver an accuracy information about bus location and arrival time

#### **4.4 Requirement analysis**

Requirements analysis is a set of operations that helps define users' expectations of the application you are building or modifying.

##### **4.4.1 System actors**

System will interact, either directly or indirectly, with the following significant roles;

- i. System administrator** - The one which deals with overall management of system
- ii. Parents** – The one who tracks the bus and receive notifications about the bus
- iii. Bus driver**-The one who transport students and send notifications once an emergence occurs.

##### **4.4.2 Use case diagram**

The use case diagram presented in the figures below uses actors and use cases to represent the functionality of the suggested system. It demonstrates how, after the data is transferred to the database, the users of the proposed system can communicate with it using the system's user interface.

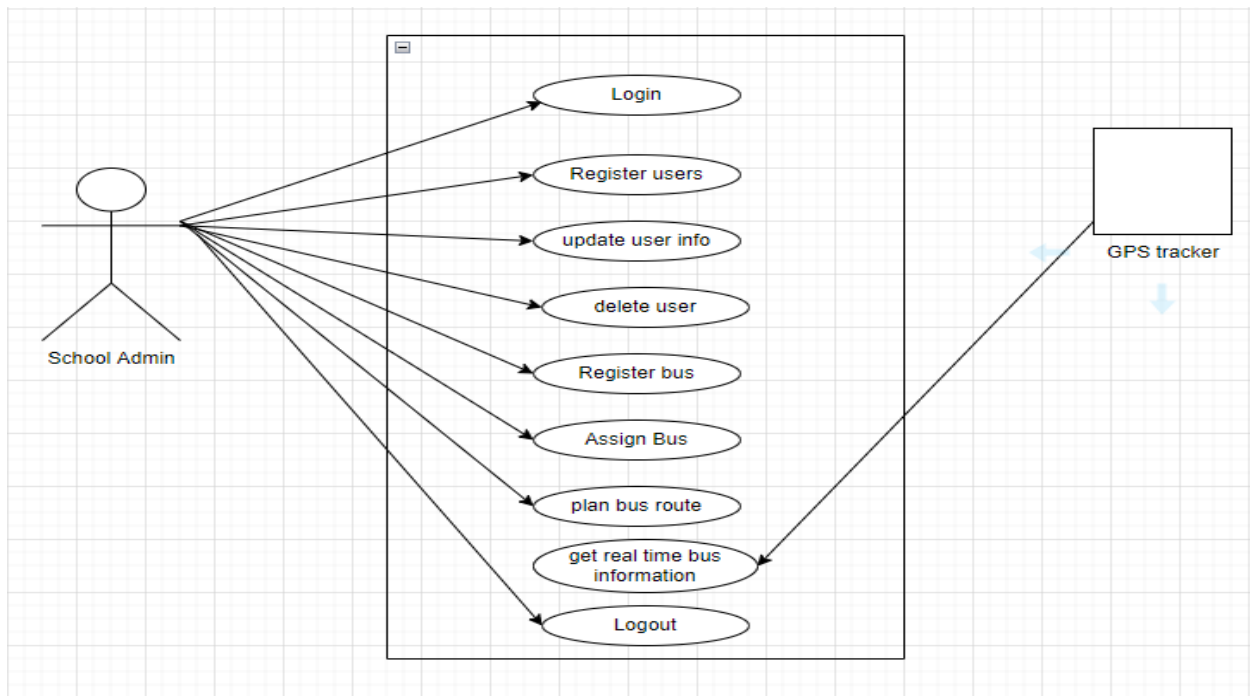


Figure 4.1: Admin and GPS tracker Use Case Diagram.

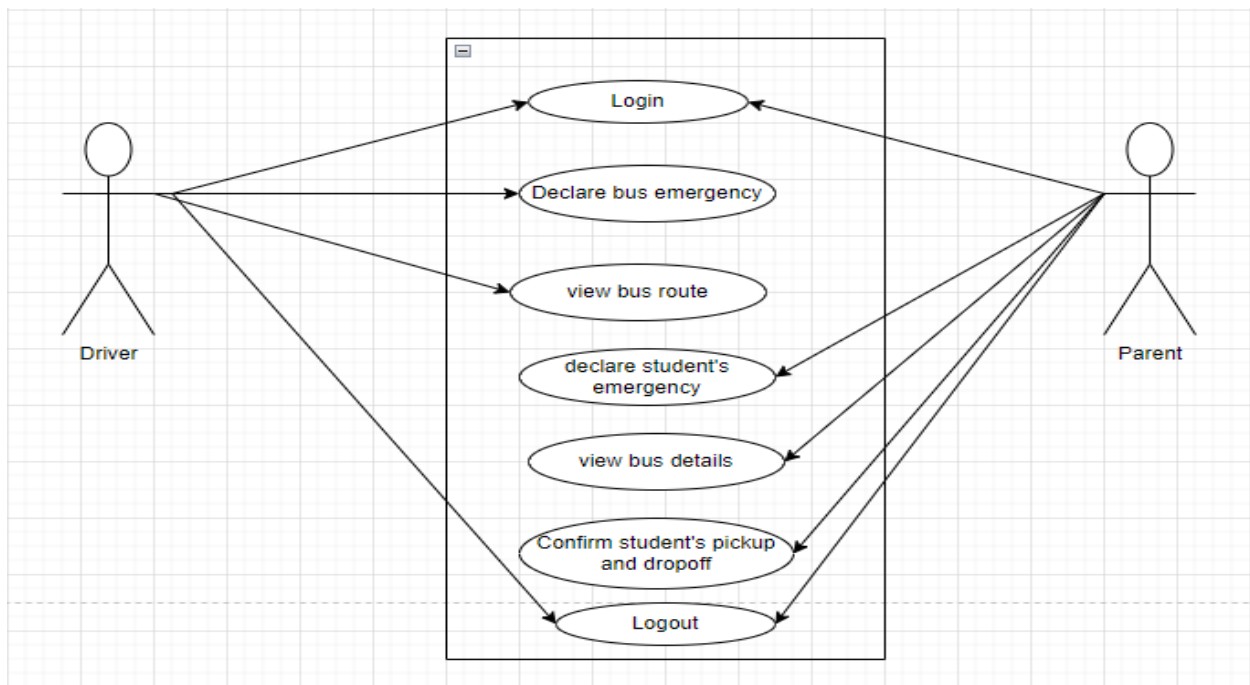


Figure 4.2: Parent and Driver Use Case Diagram.

#### 4.4.3 Use Case Descriptions

Use case description describes the process in use case between the actor and the system and the use case goals. Below are the use case descriptions.

Table 4.3: Register users use case

Field	Description
Use case:	Register Users
Actors:	School Administrator
Short description:	The school administrator registers the users and actors of the system.
Pre-condition:	The school administrator must login to the system.
Main flow:	<ol style="list-style-type: none"><li>1. The system displays the page for the specific user to be registered.</li><li>2. The admin fills in the details of the specific user to be registered.</li><li>3. The admin submits a completely filled form of the user to be registered</li></ol>
Exception flow:	If the user's details are incomplete, an error is displayed and the form is not submitted.

Table 4.4: Plan Bus Route use case

Field	Description
Use case:	Plan Bus route
Actors:	School Administrator
Short description:	The school admin assigns the buses to the drivers , and their respective routes
Pre-condition:	The buses and routes must be registered
Main flow:	<ol style="list-style-type: none"><li>1. The system displays the form with dropdown lists of routes and buses to be assigned.</li><li>2. The admin assigns the buses to the respective routes.</li></ol>



	3. The admin submits a complete assignment of the routes to the buses
Exception flow:	If the admin tries to assign a single bus to multiple routes , an error is displayed

Table 4.5: Declare emergency use case

Field	Description
Use case:	Declare bus emergency
Actors:	Driver
Short description:	The driver declares an emergency to notify the parents and school administrator
Pre-condition:	The driver must be logged in to the system
Main flow:	<ol style="list-style-type: none"> <li>1. The driver navigates to the declare emergency section</li> <li>2. The driver presses the button to send notifications to parents and school admin</li> </ol>
Post-condition:	The message is displayed for a successful emergency notification

Table 4.6: View Bus Details use case

Field	Description
Use case:	View Bus Route
Actors:	Parent
Short description:	The parents view the bus details such as the current location
Pre-condition:	The parent must be logged in to the system
Main flow:	1. The system displays the parent view 2.The parent navigates to the view bus details section
Exception-flow:	Failure for bus location to be retrieved and displayed to the system

#### 4.4.4 Class diagram

This particular static structure diagram illustrates a system's classes, their properties, actions (or methods), and relationships between objects in order to define the structure of the system.

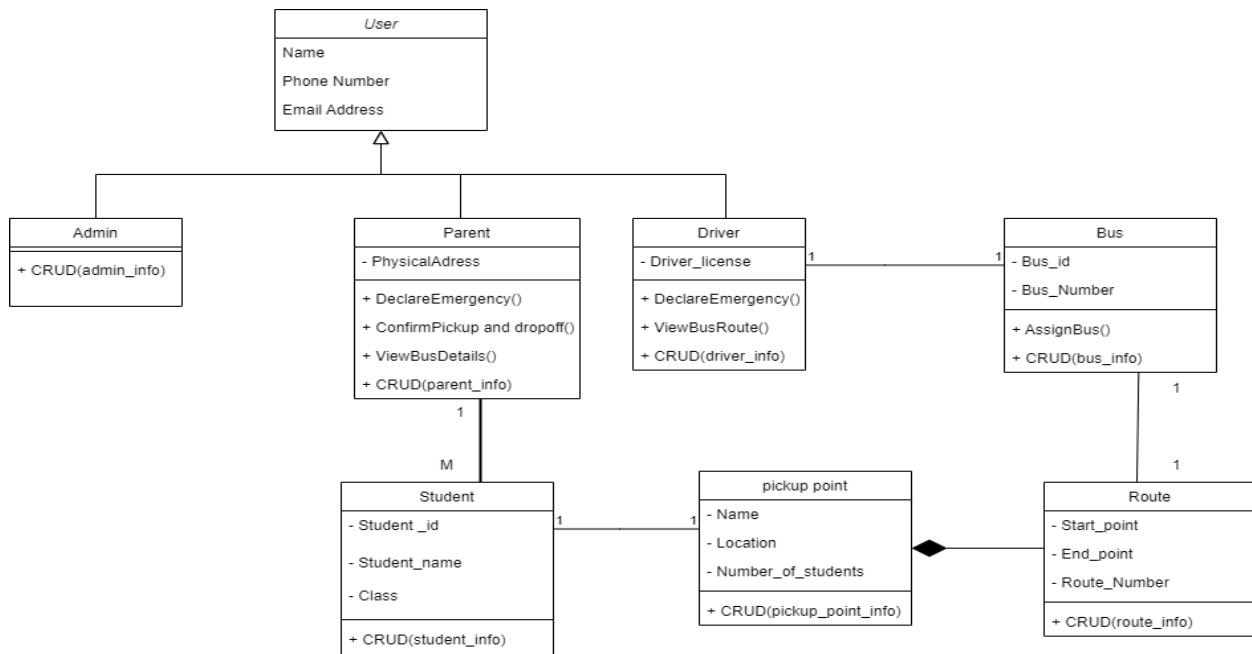


Figure 4.3: Class Diagram for the System.

## 4.5 System design.

This defines a general system architecture and serves as a meaningful representation of the system that will be created. It entails locating and outlining the underlying software system abstractions and their connections.

### 4.5.1 Architecture design

This is a representation of the data and software structures needed to construct a computer-based system. It concerns with the process of defining a collection of hardware and software components and their interfaces to establish the framework for the development of a computer system.

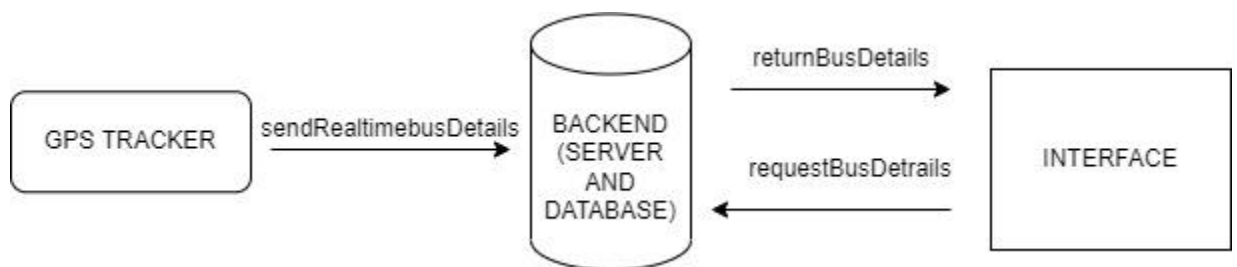


Figure 4.4: Architecture Design of System.

### 4.5.2 Sequence diagram.

A sequence diagram is used to explain how system items interact throughout time with respect to the order in which they are executed. The sequence diagram provides a clear understanding of the process by demonstrating how the system will behave and respond.

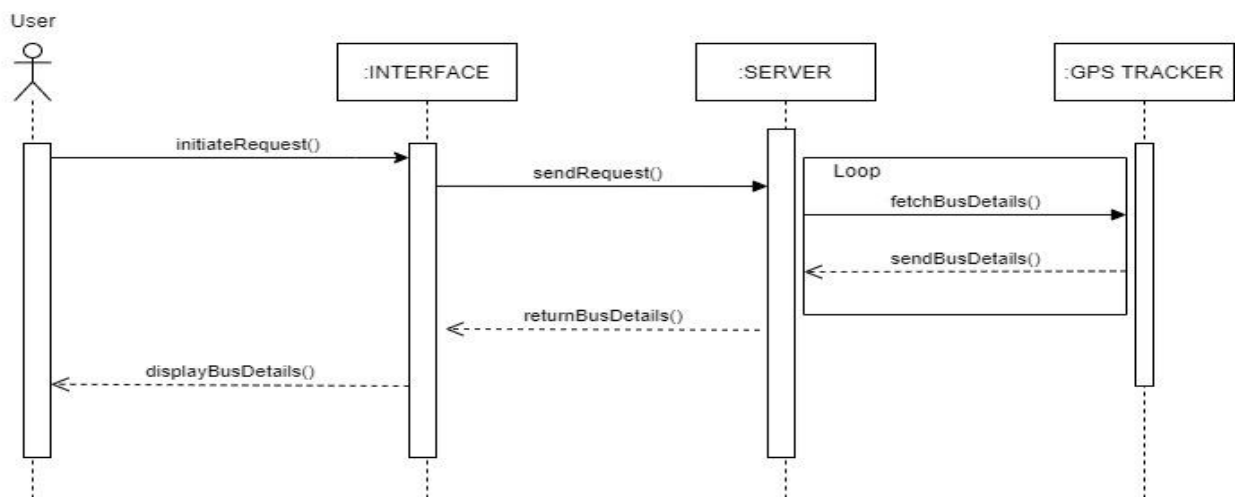


Figure 4.5: Sequence Diagram of System User.

### 4.5.3 Entity relationship diagram

An entity relational diagram is a highly conceptual diagram that displays the relationships between entities that are stored in the database. An entity can be an object having physical presence or mental existence, and these entities have characteristics that specify their properties. The entity relational diagram is then displayed in the picture below.

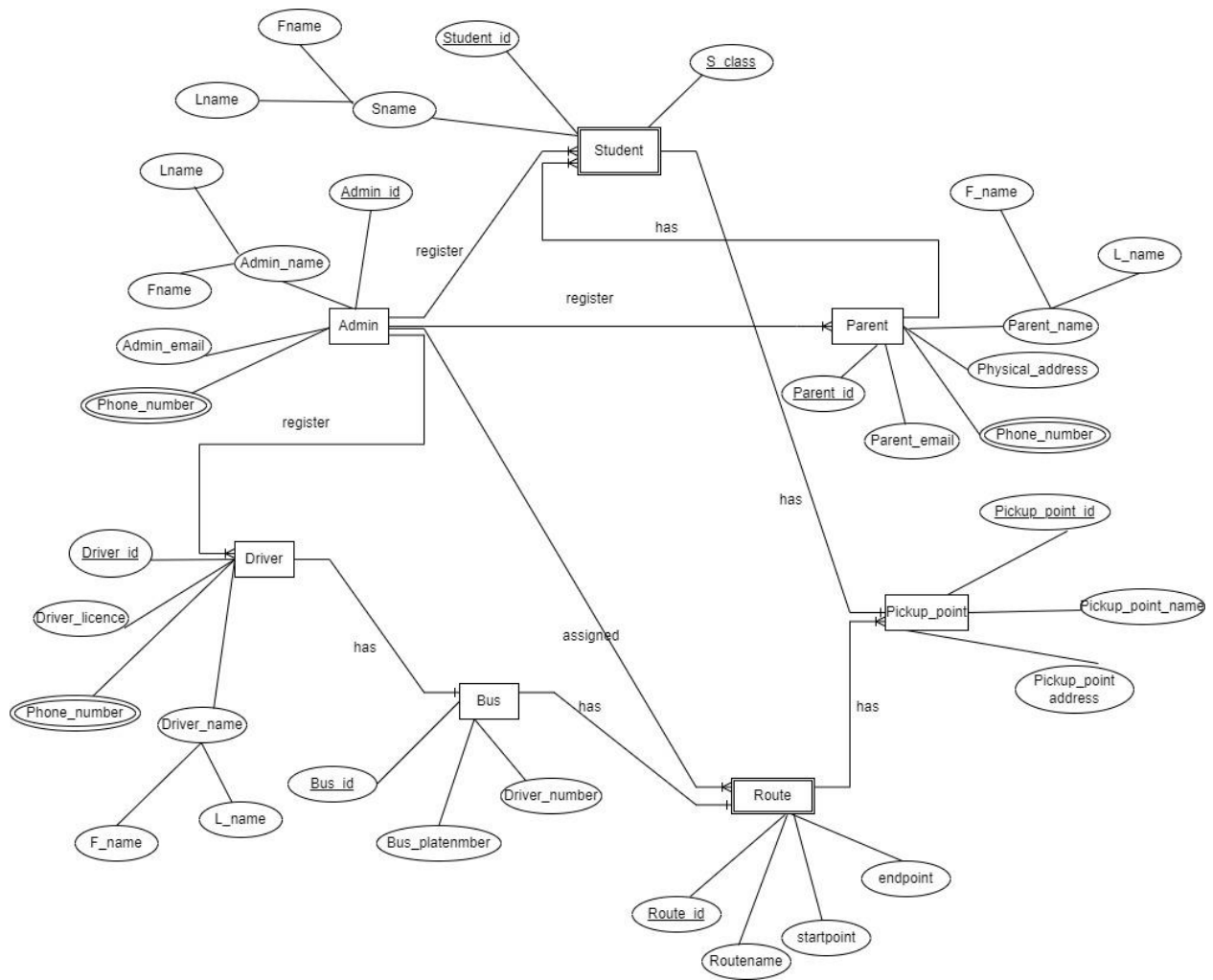


Figure 4.6: Entity Relationship Diagram for the System

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