A PROJECT REPORT ON

AVOIDING ROAD TRAFFIC CONGESTION USING PARTICLE SWARM OPTIMISATION

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY , PUNE IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE

BACHELOR OF ENGINEERING
(Computer Engineering)

BY

Adil Hussain	Exam No: B120314204
Mohammad Moheed Inamdar	Exam No: B120314249
Ajay Singh Rajpurohit	Exam No: B120314310
Utkarsh Alone	Exam No: B120314207

Under the guidance of :
Prof. Mrs. Deepti Nirwal

DEPARTMENT OF COMPUTER ENGINEERING
PES MODERN COLLEGE OF ENGINEERING
SHIVAJINAGAR,PUNE 411005

SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE
2017 - 18

CERTIFICATE

This is to certify that the Project Entitled

AVOIDING ROAD TRAFFIC CONGESTION USING PARTICLE SWARM OPTIMIZATION

Submitted by

Adil Hussain	Exam No: B120314204
Mohammad Moheed Inamdar	Exam No: B120314249
Ajay Singh Rajpurohit	Exam No: B120314310
Utkarsh Alone	Exam No: B120314207

is a bonafide work carried out by them under the supervision of Prof. Mrs. Deepti Nirwal and it is approved for the partial fulfillment of the requirement of Savtribai Phule Pune university, Pune for the award of the degree of Bachelor of Engineering (Computer Engineering).

Prof. Mrs. Deepti Nirwal
Guide
Department of Computer Engineering

Prof. Dr. Mrs. S. A. ITKAR
Head
Department of Computer Engineering

Signature of Internal Examiner

Signature of External Examiner

PROJECT APPROVAL SHEET

A Project Report Titled as

AVOIDING ROAD TRAFFIC CONGESTION USING PARTICLE SWARM OPTIMIZATION

is successfully completed by

Adil Hussain	Exam No: B120314204
Mohammad Moheed Inamdar	Exam No: B120314249
Ajay Singh Rajpurohit	Exam No: B120314310
Utkarsh Alone	Exam No: B120314207

at

DEPARTMENT OF COMPUTER ENGINEERING

PES MODERN COLLEGE OF ENGINEERING

SAVITRIBAI PHULE PUNE UNIVERSITY,PUNE

ACADEMIC YEAR 2017-2018

Prof. Mrs. Deepti Nirwal	Prof. Dr. Mrs. S. A. ITKAR
Guide	Head
Department of Computer Engineering	Department of Computer Engineering

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Acknowledgment

It gives us pleasure in presenting the project report on **'Avoiding Road Traffic Congestion using Particle Swarm Optimization'**.

Firstly, we would like to express our indebtedness appreciation to our guide **Prof. Mrs. Deepti Nirwal**. Her constant guidance and advice played very important role in successful completion of the project. She always gave us her suggestions, that were crucial in making this report as flawless as possible.

We would like to express our gratitude towards **Prof. Dr. Mrs. S. A. Itkar** Head of Computer Engineering Department, PES Modern College of Engineering for her kind co-operation and encouragement which helped us during the completion of this report.

Also we wish to thank our Principal, **Prof. Dr. Mrs. K. R. Joshi** and all faculty members for their whole hearted co-operation for completion of this report. We also thank our laboratory assistants for their valuable help in laboratory.

Last but not the least, the backbone of our success and confidence lies solely on blessings of dear parents and lovely friends.

Name1
Name2
Name3
Name4

Abstract

Traffic management is a tedious task riddled with a lot of uncertainty of buildup and flow changes. The largest issue regarding Traffic Management is its unpredictability of changes. This Project aims to tackle this issue with the use of incremental changes that counteract signs of Traffic buildup. The idea is to detect changes in the traffic density (from cycle to cycle) and slowly increase/decrease signal timings for the growing/shrinking route density or overall. This allows us to do 2 things at once, viz.

1. Prepare and provide proportional timings to each road of the signal and
2. Dynamically increase/decrease the overall signal cycle time based on density growth/reduction.

Our system is ideal for use in a Smart City environment or any environment that provides GSM internet or mobile data abilities near the roads

Keywords

Distributed Artificial Intelligence, Intelligent agents, Swarm Intelligence

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CHAPTER 1
INTRODUCTION

1.1 Brief Description

The problem statement describes a problem that is very complex to deal with. It contains many variables like density of traffic, frequency of input, probability of failure, location of failure, area/capacity of channel, etc. Finding an equation that defines the flow in the network using these variables is a tedious task as the behavior of such networks is not defined with respect to each variable. Also, conducting experiments over the network in an attempt to define relations between one variable and the traffic (keeping all other variables constant) is limited to simulations. Such experiments cannot be conducted in the real world.

Many solutions use IoT devices embedded inside vehicles (or VANET) that solve this problem by finding the density and urgency of each vehicle to adjust traffic signal timings. Other solutions use WSN to identify traffic density using infrared lasers across the road to mark low, medium and high traffic. This technique adapts the traffic signal based on the amount of backlog in each lane that builds up over the "red" duration of the traffic signal for a given lane.

We observe that these variables have slow variations over time for the case of Road Traffic. This allows us to observe activities as they happen and make changes to accommodate the traffic. Our solution uses Incremental Approach since it is a common approach used to tackle problems in slowly changing systems. It solves these issues by developing a continual monitor-evaluate-modify loop that tends to adapt to problems with no single solution.

1.2 Detailed problem definition

Problem statement City Road Traffic has been on the rise for the past 6 years. Increase in road sizes has not been able to solve this issue. Devise a secure solution to the traffic management problem. Solution must be independent of environment conditions and should be easily install-able.

1.3 Justification of problem

Due to overpopulation traffic is increasing at exponential rate and time required to travel from one place to another is increasing. The cost of making flyover and/or undergroud roadways is high and sometimes not possible. Existing traffic management system can not be easily installed or maintained in tough traffic condition like those of India.

1.4 Purpose of your system

1. Prevents generating traffic jams.
2. Less chances of accident as the roads are more free.
3. Better fuel economy of vehicle.
4. Overall cleaner air.

1.5 Literature survey

Sr. No.	Title	Author	Journal	Purpose
1	An Integrated and Scalable Platform for Proactive Event-Driven Traffic Management	Alain Kibangou, Alexander Artikis *et. al*	ArXiv.org, March 2017	SPEEDD project, ML predictive approach
2	Self-organizing Traffic Lights	Carlos Gershenson	Complex Systems, 2005	Naive Distributed Traffic Signal Control
3	Centralized and Localized Data Congestion Control Strategy for Vehicular Ad Hoc Networks Using a Machine Learning Clustering Algorithm	Nasrin Taherkhani and Samuel Pierre	IEEE Transactions on Intelligent Transportation Systems, 2016	Example of Ad-Hoc Approach (VANET)

Table 1.1: Literature Survey

CHAPTER 2
ANALYSIS

2.1 Project Plan

Sr. No.	Day and Date	Topics Discussed	Suggestion of Project Guide
1	Tuesday, 22^{nd} August 2017	Base Paper, Topic, Tools Decided.	
2	Monday, 18^{th} September 2017	Seeking Algorithm class/style.	
3	Thursday, 28^{th} September 2017	Partial Presentation made.	
4	Wednesday, 11^{th} October 2017	Synopsis made.	
5	Tuesday, 24^{th} November 2017	Partial UML Diagrams completed (Structural).	
6	Monday, 11^{th} December 2017	SRS Textual Content completed Partial Behavioural Diagrams completed (Use case, Statechart, Sequence).	
7	Wednesday, 13^{th} December 2017	Completed UML Diagrams (Activity) and ER Diagram. Partial Project Report completed.	
8	February 2018 End	Data Collection Completed	
9	Mid January 2018	Algorithm Design Completed	
10	January 2018 End	Hardware Design and Testing Completed	
11	February 2018 End	UI Design and Testing Completed	
12	Mid March 2018	Algorithm Testing using Data Collected	

2.2 Requirement analysis

2.2.1 Necessary Functions:

- Dynamically scale signal timings as per lane's incoming traffic.
- Dynamically reduce/eliminate the onset of traffic jams.
- On-the-fly Route configuration and modification.
- Visible Timings (Exposed info) of each signal controller.
- Authentication and User creation for Traffic Control Administrator(s).
- Automatic Detection, Reporting and Adaptation to Signal Controller Failures.

2.2.2 Desirable Functions:

- Android application to warn users of new changes in the Traffic system.
- Android webview of web interface to see Traffic status.
- Provision for adapting to emergency services (ambulance,fire brigade, etc.)

2.3 Team structure

Adil Hussain
Moheed Inamdar
Ajay Rajpurohit
Utkarsh Alone

All work like ananlysis, design, coding, testing, documentation and presentation has been done equally.

CHAPTER 3
DESIGN

3.1 Architectural Block Diagram

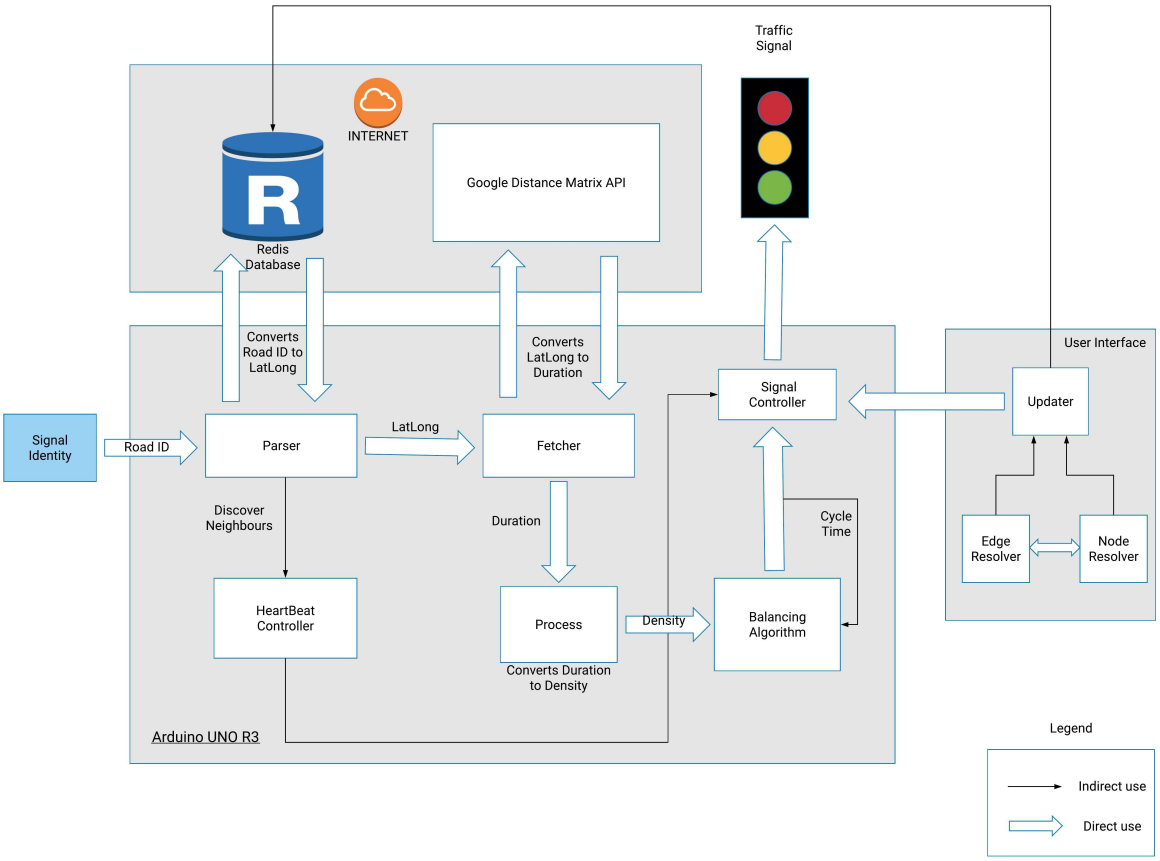

Figure 3.1: Architecture Diagram

3.2 Software Requirement Specification (SRS)

3.2.1 Interface Requirements:

User interfaces:

1. UI for visitors to see signal timings.
2. UI for authentication of Traffic Control Administrators.
3. UI for editing (with support for undo/redo) routes and signal operation.
4. Exposed API for using non-authenticated functionalities outside of UI.

Hardware Interfaces

1. A hidden P2P communication strategy for real-time monitoring network status.
2. Automatic route expansion in case of signal controller failure.

Software Interfaces:

1. Hidden P2P localhost server for notifying lane neighbours.
2. Web server to Controller interface for operating on controller (switching on/off, changing route, watching timings).

Communication Interfaces:

1. 3G/4G GSM internet connection.
2. IoT connectivity between signal controllers.

3.3 Risk assessment

CHAPTER 4
MODELLING

4.1 UML diagrams

4.1.1 Structural Diagrams

4.1.1.1 Class Diagram

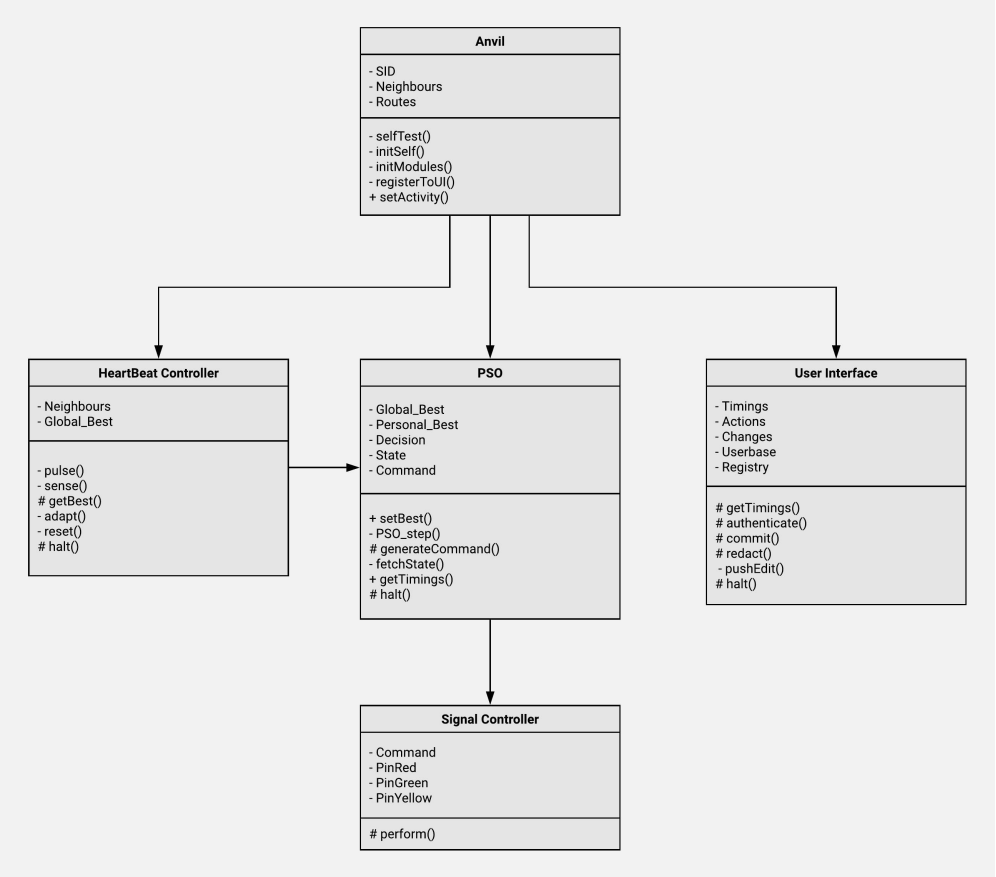

Figure 4.1: Class Diagram

4.1.1.2 Object Diagram

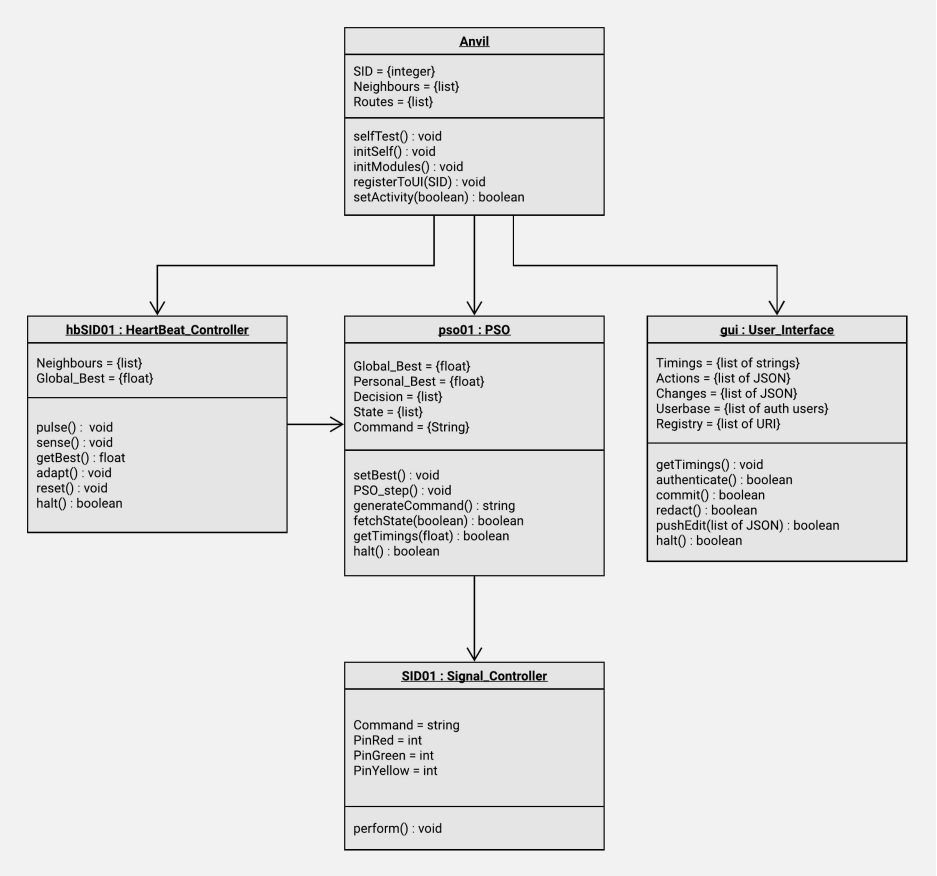

Figure 4.2: Object Diagram

4.1.1.3 Component Diagram

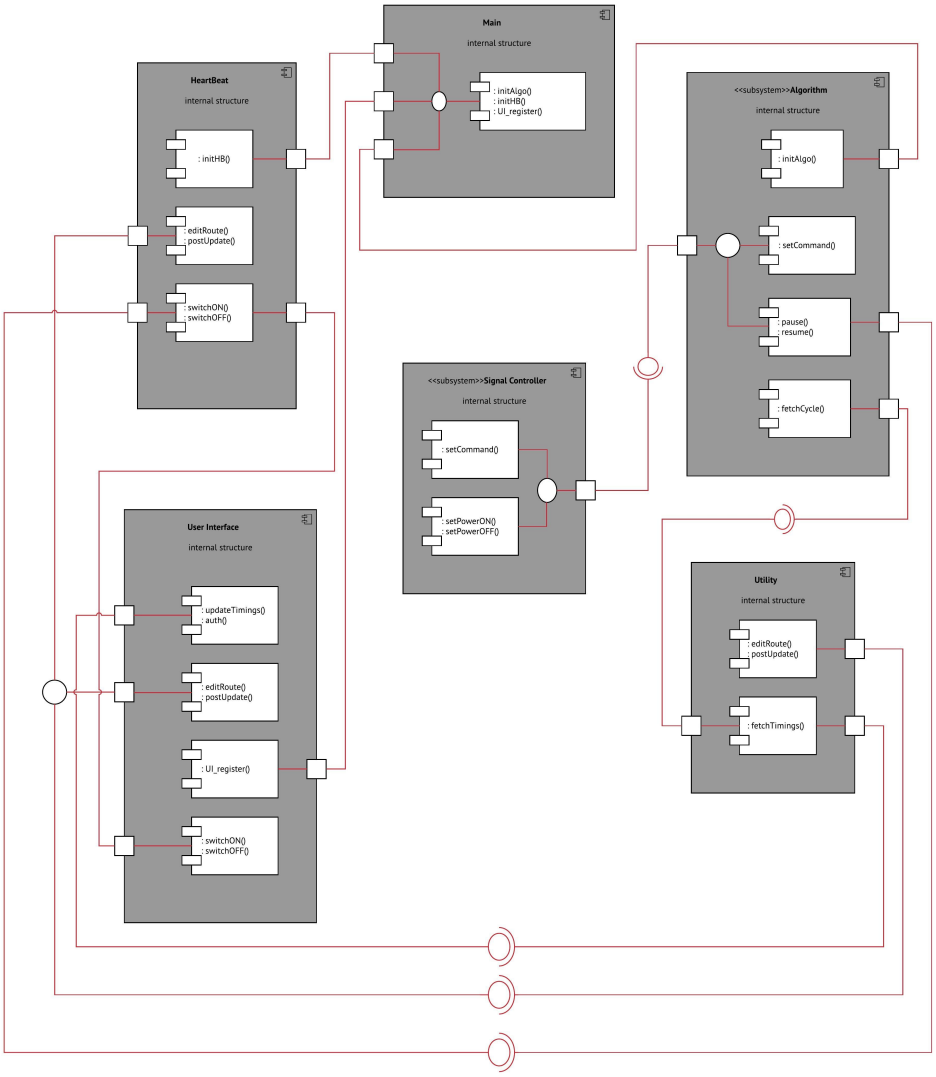

Figure 4.3: Component Diagram

4.1.2 Behavioural Diagrams

4.1.2.1 Use Case Diagram

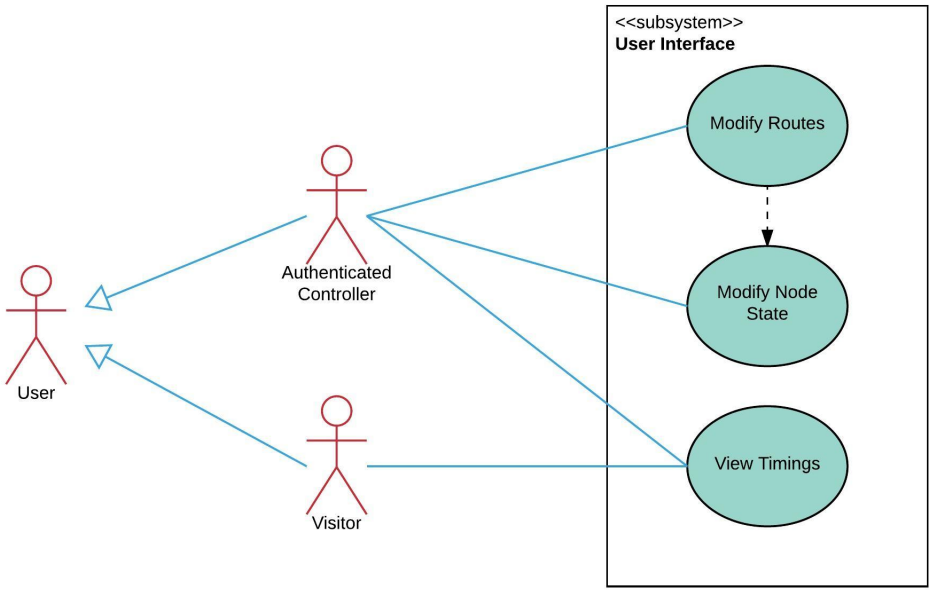

Figure 4.4: Use Case Diagram

4.1.2.2 StateChart Diagram

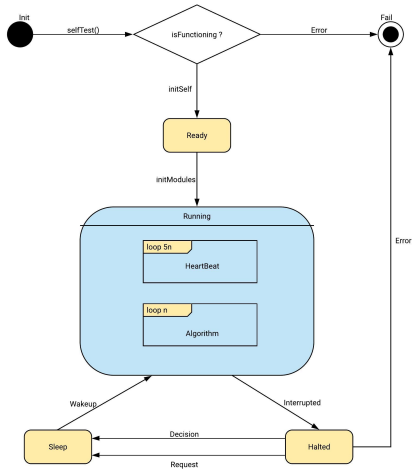

Figure 4.5: StateChart Diagram

4.1.2.3 Sequence Diagrams

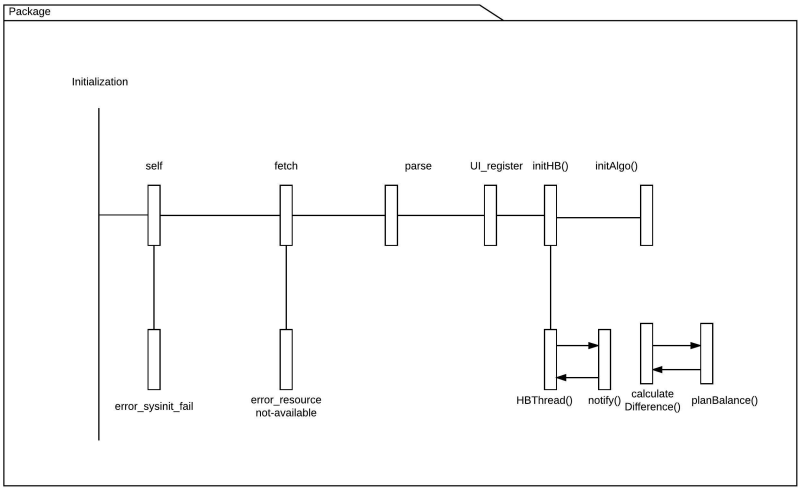

Figure 4.6: Initialization Sequence

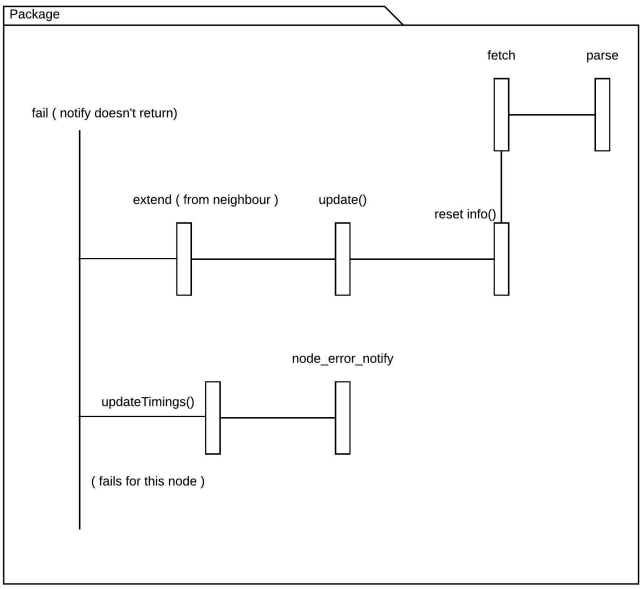

Figure 4.7: Sequence for Failure of a Node

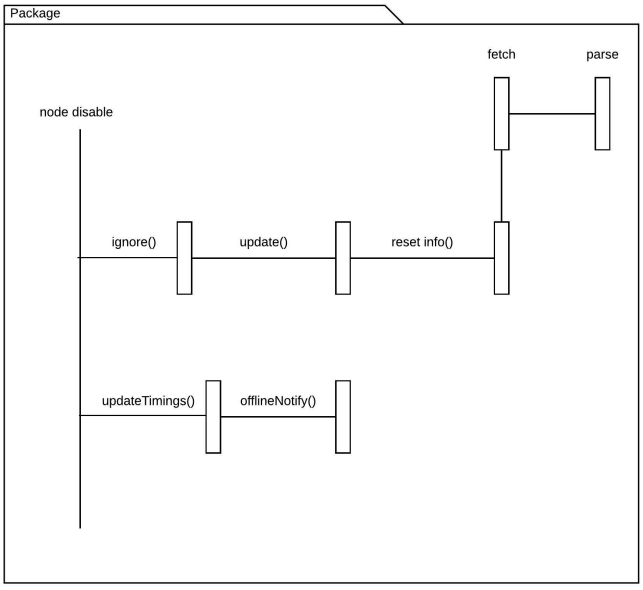

Figure 4.8: Node Removal Sequence

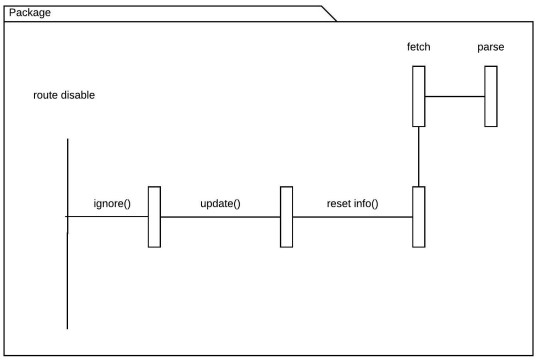

Figure 4.9: Route Modification Sequence

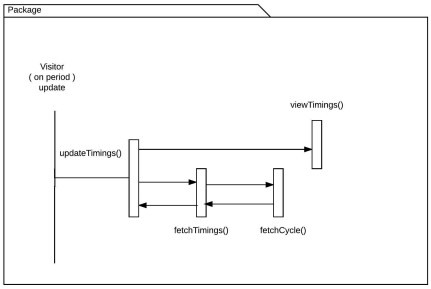

Figure 4.10: Visitor's Usage Sequence (uncached data)

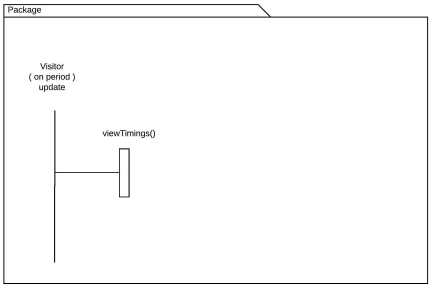

Figure 4.11: Visitor's Usage Sequence (cached data)

4.1.2.4 Activity Diagram

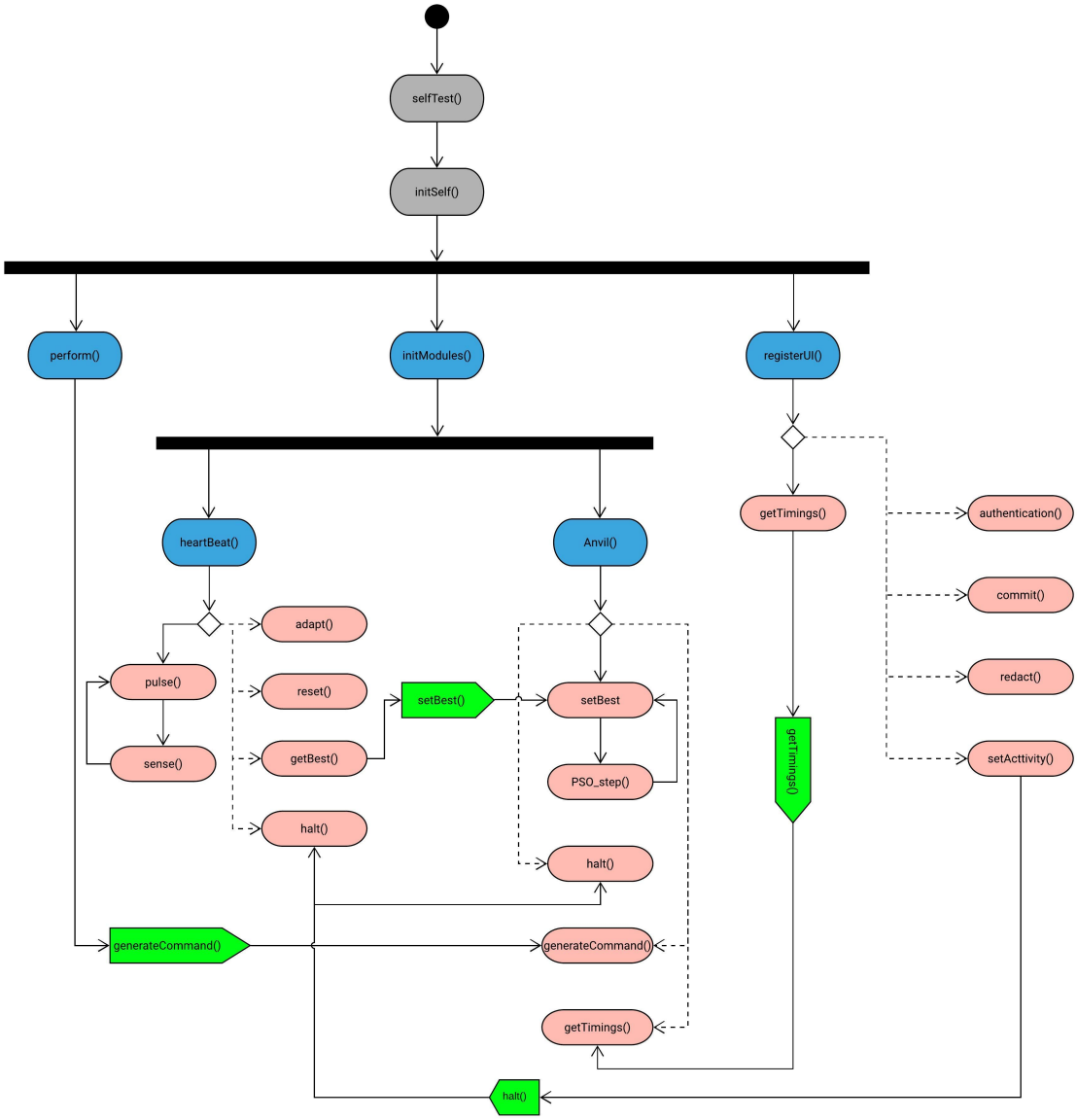

Figure 4.12: Activity Diagram

4.2 ERD and Normalization for database if any

4.2.1 Entity Relationship Diagram

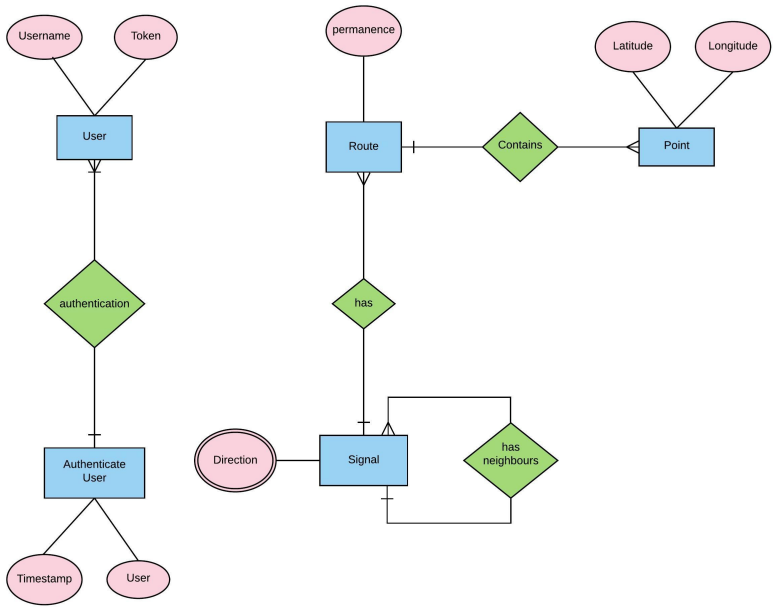

Figure 4.13: ER Diagram

CHAPTER 5
CODING

5.1 Algorithms / Flowcharts

5.2 Software used

- MOTUS tool (Mircroscopic Open Traffic Simulator)
- Redis Database
- python-json
- Django web server (modified)
- GoogleMaps web API

5.3 Hardware specification

- LoRa comms wireless card.
- Atmega or ESP microprocessor board.

5.4 Programming language

- JavaScript
- HTML+CSS
- Embedded C / Python (test phase)

5.5 Platform

- Atmega/ESP/STM32 core microcontroller.
- Google Cloud Service.

5.6 Components

5.7 Tools

- Arduino IDE
- Git (hosted over Github)
- LEMP stack (Linux + Nginx + MySQL + Python)

CHAPTER 6
RESULTS

CHAPTER 7
TESTING

7.1 Formal technical reviews

7.2 Test plan

7.3 Test cases

7.4 Test Results

(Unit, integration, regression, system, alpha, Beta)

CHAPTER 8

DEPLOYMENT AND MAINTENANCE

CHAPTER 9

CONCLUSION AND FUTURE SCOPE

Write summary , conclusion in 50 words and future scope

REFERENCES

- Follow the format strictly.

ANNEXURE A

LABORATORY ASSIGNMENTS FROM TERM I

ANNEXURE B

LABORATORY ASSIGNMENTS ON PROJECT QUALITY AND RELIABILITY TESTING OF PROJECT DESIGN

It should include assignments such as

- Use of divide and conquer strategies to exploit distributed/parallel/concurrent processing of the above to identify object, morphisms, overloading in functions (if any), and functional relations and any other dependencies (as per requirements). It can include Venn diagram, state diagram, function relations, i/o relations; use this to derive objects, morphism, overloading

- Use of above to draw functional dependency graphs and relevant Software modeling methods, techniques including UML diagrams or other necessities using appropriate tools.

- Testing of project problem statement using generated test data (using mathematical models, GUI, Function testing principles, if any) selection and appropriate use of testing tools, testing of UML diagram's reliability. Write also test cases [Black box testing] for each identified functions. You can use Mathematica or equivalent open source tool for generating test data.

- Additional assignments by the guide. If project type as Entreprenaur, Refer [**?**],[**?**],[**?**], [**?**]

ANNEXURE C

REVIEWERS COMMENTS OF PAPER SUBMITTED

(At-least one technical paper must be submitted in Term-I on the project design in the conferences/workshops in IITs, Central Universities or UoP Conferences or equivalent International Conferences Sponsored by IEEE/ACM)

1. Paper Title:
2. Name of the Conference/Journal where paper submitted :
3. Paper accepted/rejected :
4. Review comments by reviewer :
5. Corrective actions if any :

ANNEXURE D
PLAGIARISM REPORT

Plagiarism report

ANNEXURE E

TERM-II PROJECT LABORATORY ASSIGNMENTS

1. Review of design and necessary corrective actions taking into consideration the feedback report of Term I assessment, and other competitions/conferences participated like IIT, Central Universities, University Conferences or equivalent centers of excellence etc.

2. Project workstation selection, installations along with setup and installation report preparations.

3. Programming of the project functions, interfaces and GUI (if any) as per 1 st Term term-work submission using corrective actions recommended in Term-I assessment of Term-work.

4. Test tool selection and testing of various test cases for the project performed and generate various testing result charts, graphs etc. including reliability testing.
   Additional assignments for the Entrepreneurship Project:

5. Installations and Reliability Testing Reports at the client end.