

ANNA UNIVERSITY : CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report “*GPS BASED TRACKING SYSTEM FOR GOVERNMENT BUSES USING IoT*” is the bonafide work of “**Hariharan S (822721104020), Pratheeba S (822721104037), Aravind S (822721104301), Jagadeshan M (822721104021)**”, who carried out the project work under my supervision.

SIGNATURE

Dr. K. MANOJKUMAR, M.E, Ph. D.

HEAD OF THE DEPARTMENT

Associate Professor

Department of CSE

Government College of Engineering

Sengipatti

Thanjavur - 613402

SIGNATURE

Dr. G. INDIRANI, M.E, Ph.D.

SUPERVISOR

Associate Professor

Department of CSE

Government College of Engineering

Sengipatti

Thanjavur - 613402

Submitted for CS3811 – Project Work viva–voce Examination held on _____.

INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

The Real-Time Bus Tracking System is an innovative IoT-based solution designed to revolutionize public transportation by providing accurate, real-time bus location data and arrival predictions to passengers and transit authorities. The system leverages GPS technology (Neo-6M module) and ESP32 microcontrollers to capture live bus coordinates (latitude, longitude, and speed) at 5-second intervals, ensuring up-to-date tracking. By integrating a Flask-based web interface with Firebase Realtime Database, the system processes and displays bus locations dynamically, enabling passengers to make informed travel decisions.

At its core, the system employs the Haversine formula to calculate the distance between a bus's current GPS position and predefined bus stops, automatically updating the bus's "current stop" when within a 200-meter threshold.

For passengers, the system offers two key modules:

Bus-Specific Tracking: Users can input a unique bus ID to view the bus's current stop, route progression, and estimated arrival time (ETA) at their selected boarding point.

Route-Based Search: Passengers can enter start and destination stops to retrieve a list of available buses, their current locations, and ETAs, presented in an intuitive tabular format with visual route maps.

The ETA calculation algorithm compares the bus's current stop index with the user's selected stop along the route. If the bus hasn't passed the stop, the system sums the distances between intermediate stops and divides by the bus's current speed (fetched from GPS) to predict arrival time. Results are displayed as both clock time (e.g., 10:15 AM) and time remaining (e.g., "8 minutes"), enhancing usability.

Key innovations include:

IoT Hardware Integration: Neo-6M GPS + ESP32 provides <2.5m accuracy and low-power operation (4300mAh batteries).

Dual-Layer Security: Firebase authentication and encrypted GPS data transmission.

Dynamic ETA Calculation: Combines real-time speed and route topology for precision.

Scalability: Supports 500+ buses with Firebase's serverless architecture.

Pilot testing demonstrated a 40% reduction in passenger wait times and 90% satisfaction rates. Future enhancements include mobile app integration, crowd analytics, and traffic-aware ETA adjustments.

ACKNOWLEDGEMENT

This project work is dedicated to Almighty God blessing with inspirational parents, teachers and good friends.

We are extremely thankful with no words of formal nature to the dynamic principal of our college **Dr.S.JAYABAL Ph.D.**, for providing all the necessary facilities to complete our work.

We would like to thank **Dr.K.MANOJKUMAR M.E, Ph.D**, Associate Professor, Head of the Department, Department of Computer Science and Engineering for his motivation and encouragement in completing this project work.

We would like to express our sincere gratitude and heartfelt thanks to our well-wisher and our Project coordinator **Dr. G. INDIRANI M.E, Ph.D.**, Associate Professor for her valuable guidance and her constant efforts to make this project a successful one.

We are grateful to all the faculty members of the Computer Science and Engineering Department, for their valuable support.

We also like to express our sincere thanks and gratitude to our parents and friends for their continuous encouragement and support.

TABLE OF CONTENTS

CHAPTER No.	TITLE	PAGE NO:
	ABSTRACT	II
	ACKNOWLEDGEMENT	III
	TABLE OF CONTENTS	IV
	LIST OF FIGURES	VII
	LIST OF TABLES	VIII
	LIST OF ABBREVIATIONS	IX
1.	INTRODUCTION	1
2.	LITERATURE SURVEY	3
	2.1. Real-Time Passenger Information Systems	3
	2.2. Google Transit Feed Specification (GTFS) Integration	3
	2.3. IoT-Based Tracking Solutions	3
	2.4. ETA Estimation Algorithms	3
	2.5. Breakdown Detection Mechanisms	4
	2.6. Web Technologies for Real-Time Tracking	4
3.	EXISTING SYSTEM	5
	3.1. Fixed Timetable Systems	5

	3.2. SMS-based Information Services	5
	3.3. High-Cost GPS Solutions	5
	3.4. Lack of Breakdown Monitoring	5
4.	PROPOSED SYSTEM	6
	4.1. Features of the Proposed System	6
	4.2. Working Model	6
	4.3. Advantages Over Existing Systems	7
5.	FEASIBILITY STUDY	8
	5.1. Economic Feasibility	8
	5.2. Technical Feasibility	8
	5.3. Social Feasibility	8
6.	SYSTEM REQUIREMNT	9
	6.1. Hardware Requirement	9
	6.2. Software Requirement	13
7.	SOFTWARE DESCRIPTION	16
	7.1. Python	16
	7.2. Flask	16
	7.3. SQLAlchemy	17
	7.4. Firebase	17
8.	SYSTEM DESIGN	18

	8.1. Architecture Design	18
	8.2. Flow of System	20
9.	SYSTEM IMPLEMENTATION	21
	9.1. GPS Data Acquisition Module	21
	9.2. Bus Position Update Module	21
	9.3. ETA Calculation Module	21
	9.4. Breakdown Detection Module	22
10.	SYSTEM TESTING	23
	10.1. Output Screens	23
	10.2. Analysis of Real-Time Accuracy	23
	10.3. Summary of Key Results	23
	10.4. Performance Testing	24
11.	RESULT AND DISCUSSION	25
	11.1. Output Screens	25
	11.2. Analysis of Real-Time Accuracy	25
	11.3. Summary of Key Results	26
	CONCLUSION AND FUTURE ENHANCEMENT	27
	APPENDIX 1	28
	APPENDIX 2	40
	REFERENCE	43

LIST OF FIGURES

Fig. No.	Description	Page. No.
1.1	Hardware Setup	2
6.1.1	Hardware Used	12
6.2.2	Software Used	15
8.1.1.1	Architecture Diagram	19
1	Home Page with Bus Stop Selector	40
2	Bus Dashboard showing ETA and route list	40
3	Route Visualization with progress indicator	41
4	Firebase structure	41
5	Check Arrival Time	42
6	View Route Map	42

LIST OF TABLES

Table. No.	Description	Page. No.
2.7	Summary of Gaps Addressed	4
4.1	Features of the Proposed System	6
4.3	Advantages Over Existing System	7
6.1	Hardware Requirement	9
6.2	Software Requirements	13
10.1.1	Test Case Examples	24
11.3	Summary of Key Results	26

LIST OF ABBREVIATIONS

GPS	-	Global Positioning System
ETA	-	Estimated Time of Arrival
ORM	-	Object Relational Mapping
UK	-	United Kingdom
USA	-	United States of America
LED	-	Light Emitting Diode
GSM	-	Global System for Mobile communication
GTFS	-	Google Transit Feed Specification
RAM	-	Random Access Memory
ROM	-	Read Only Memory
PCB	-	Printed Circuit Board
LCD	-	Liquid Crystal Display
IDE	-	Integrated Development Environment
RTDB	-	Real-Time Data Base
API	-	Application Programming Interface
HTML	-	Hyper Text Markup Language
CSS	-	Cascading Style Sheets
AWS	-	Amazon Web Service
HTTP	-	Hyper Text Transfer Protocol
RDBMS	-	Relational Data Base Management System
SDK	-	Software Development Kit