VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"Jnana Sangama", BELAGAVI-590018

A SEMINAR REPORT

on

"DESIGN OF HIGHWAY INTELLIGENT TRANSPORTATION SYSTEM BASED ON THE INTERNET OF THINGS AND ARTIFICIAL INTELLIGENCE"

A Seminar report submitted in partial fulfilment of the requirements for the VIII Semester degree of

Bachelor of Engineering

in

ELECTRONICS AND INSTRUMENTATION ENGINEERING

Submitted by:

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CERTIFICATE

Certified that the seminar work entitled **"Design Of Highway Intelligent Transportation System Based On The Internet Of Things And Artificial Intelligence"** has been successfully carried out by **Pranamya H.S. (1RN20EI029)**, presently VIII semester students of **RNS Institute of Technology** in partial fulfilment of the requirements for the award of degree in **Bachelor of Engineering** in **Electronics and Instrumentation Engineering** of **Visvesvaraya Technological University, Belagavi** during academic year 2023-2024. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in it and satisfies the academic requirements in respect of Seminar work for the said degree.

P. Latha	**Dr. Andhe Pallavi**	**Dr. Ramesh Babu H S**
Assistant Professor	**Prof. & HoD**	**Principal**

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DECLARATION

I, **Pranamya H.S.** student of VIII Semester BE, in Electronics and Instrumentation Engineering, RNS Institute of Technology hereby declare that the Seminar Report work entitled "**Design Of Highway Intelligent Transportation System Based On The Internet Of Things And Artificial Intelligence**" has been carried out by me and submitted in partial fulfillment of the requirements for the VIII Semester degree of Bachelor of Engineering in Electronics and Instrumentation Engineering of Visvesvaraya Technological University, Belagavi during academic year 2023-2024.

Place: Bengaluru

Date:

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ABSTRACT

The transportation industry is rapidly evolving, and there's a lot of focus on developing smart highway systems within the Internet of Things (IoT) framework. This study aims to blend modern information technology with transportation management and operations effectively. Firstly, it delves into understanding the fundamentals of IoT and intelligent transportation, then assesses the feasibility of implementing intelligent transportation using IoT on highways. Next, it analyzes the design requirements for a Highway Intelligent Transportation System (ITS) and proposes an architecture that integrates various advanced technologies such as information, communication, and control, structured into perceptual, transport, and application layers. Finally, it outlines the key application functions of the highway ITS.

The findings indicate that the maintenance management system's efficiency in handling emergencies before equipment failure surpasses traditional methods. Moreover, user satisfaction and operational efficiency have notably improved with the updated system, indicating its superiority over conventional traffic management approaches. Public expectations for this innovative system are high, showcasing its alignment with public desires for effective highway traffic management. Ultimately, this paper aims to advance transportation informatization and intelligence, enhance transportation system efficiency, and bolster safety through IoT technology.

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Chapter 1

INTRODUCTION

Currently, society is undergoing the Fourth Industrial Revolution, largely driven by information technology. This means that information is becoming increasingly important for social development. The traditional ways we used to get and use information aren't keeping up with the times anymore. As technology advances, we're seeing more attention being given to the Internet of Things (IoT), which is being used in various areas like smart cities, transportation, and agriculture. The IoT connects objects and people through a smart network, linking the physical world with the virtual world. This helps society become more focused on gathering and using information.

In recent years, cities have been improving their traffic systems thanks to upgraded intelligent transportation systems (ITS) and better road planning. Combining IoT and artificial intelligence (AI) with transportation systems has become a popular way to improve traffic flow. IoT involves connecting any object to the internet to share information using sensors like RFID, infrared, and GPS. It helps in identifying, tracking, and managing objects efficiently. IoT is now being used in transportation systems to collect real-time data about vehicles and roads, which helps in better management and reducing accidents.

Based on research and the challenges faced by ITS, a new approach is being proposed for building efficient transportation systems. This involves explaining basic IoT concepts and related AI technologies, analyzing the feasibility of using IoT in highway transportation, and designing the ITS architecture. The architecture includes three layers: perception, transmission, and application layers, which together form a new and innovative transportation system.

Chapter 2

LITERATURE SURVEY

Kaffash et al. (Year) pointed out the growing need for data-driven methods in Intelligent Transportation Systems (ITS) due to the abundance of data available. They discussed how big data algorithms are enhancing various aspects of transportation, such as signal recognition and traffic flow prediction.

Saharan et al. (Year) extensively analyzed dynamic pricing technology in ITS, highlighting its benefits in congestion control and peak load reduction. They compared its application with other technologies and discussed evaluation parameters and limitations.

Lv et al. (Year) proposed improvements to ITS through deep learning to reduce data transmission delay and improve prediction accuracy.

Yang et al. (Year) emphasized the importance of considering various infrastructure projects and traffic objects in IoT-based ITS. They discussed developing intelligent management service systems for smooth transportation operation.

Liu and Ke (Year) discussed the application of transportation IoT and designed an ITS based on the national standard of IoT. They provided insights into systems like parking management and public transport management.

Chapter 3

METHODOLOGY

IoT Overview:
The Internet of Things (IoT) is super cool! It's all about connecting everyday objects to the internet, making them smarter and more interactive. Imagine your fridge telling you when you're out of milk or your watch tracking your steps and heart rate. That's the magic of IoT! It started with simple things like connecting computers, but now, it's all about connecting everything, from your smartphone to your toaster.

IoT Architecture:
So, how does IoT work? Well, it's like a big network with different layers. First, you have the "perception layer," where all the data is collected from sensors and devices. Then, there's the "network transmission layer," which is like the highway that carries all the data to different places. Finally, there's the "information processing application layer," where all the data gets sorted and turned into useful information for us to use.

AI Overview:
Artificial Intelligence (AI) is like having a super-smart computer that can think and learn like a human. It's kind of mind-blowing! AI is everywhere these days, from helping us find the best route on Google Maps to suggesting what movie to watch on Netflix. It's like having a little helper that can understand and predict what we need.

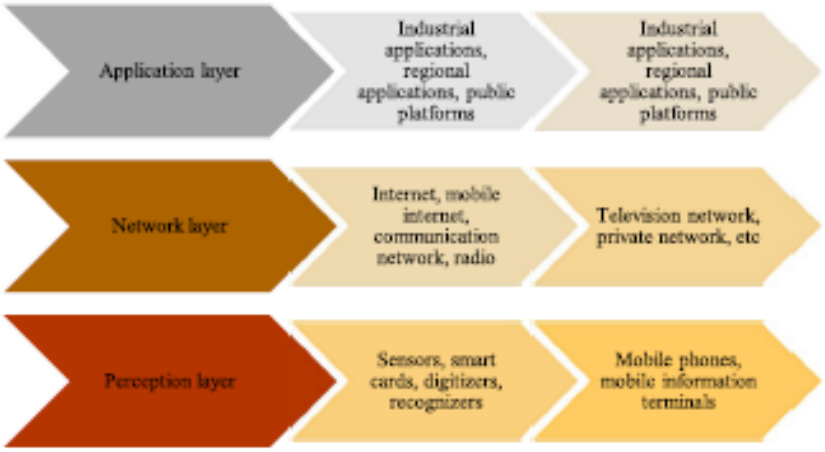

FIGURE 1. The architecture of IoT technology.

AI in Highway Inspection:
Now, here's where things get really interesting. Imagine if we could use AI to make our highways safer and more efficient. With AI-powered inspection vehicles, we can spot problems on the road faster and more accurately. These vehicles are like super-sleuths, scanning the road for cracks, potholes, and other

issues that could cause accidents. Plus, AI detection robots can go even further, using fancy sensors and algorithms to analyze the data and come up with solutions to fix the problems.

Intelligent Transportation:
Intelligent Transportation is like the future of getting around. It's all about using technology to make our roads safer, our cars smarter, and our cities more efficient. With things like smart traffic lights and self-driving cars, we can reduce traffic jams, save fuel, and cut down on pollution. It's like having a personal assistant for your commute.

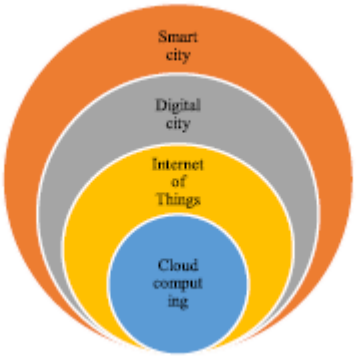

FIGURE 2. Composition of a smart city.

Highway ITS Design:
Designing a Highway Intelligent Transportation System (ITS) involves making our roads safer, reducing traffic congestion, and improving overall transportation efficiency. It's like giving our highways a digital makeover to make them smarter and more responsive to the needs of drivers and transportation authorities.

FIGURE 3. Demand analysis of administrative departments.

FIGURE 4. Operator demand analysis.

Before diving into the design process, it's essential to identify who the system is for. We have different stakeholders like government transportation departments, highway operators, drivers, and even businesses that rely on efficient transportation. Understanding their needs and requirements helps us tailor the ITS to serve everyone effectively.

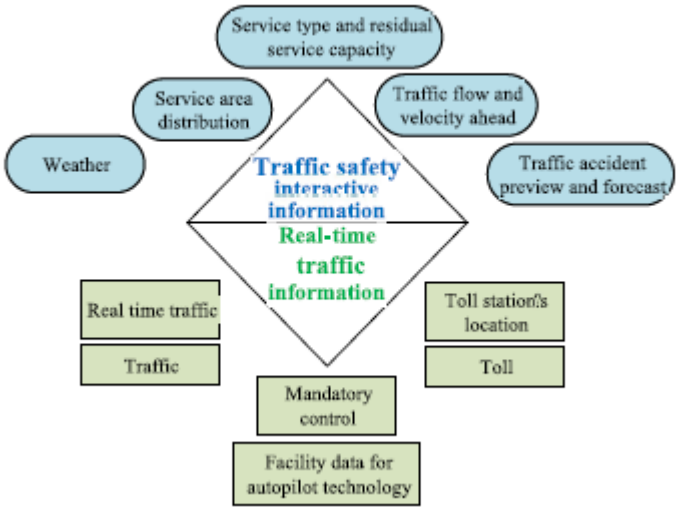

FIGURE 5. Demand analysis of the demander.

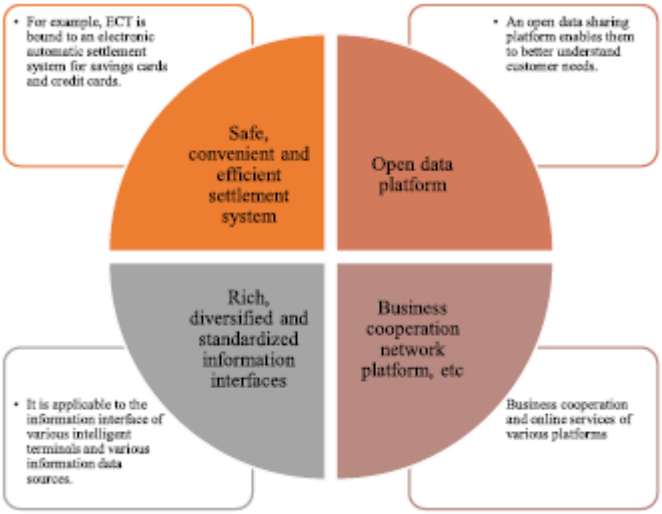

FIGURE 6. Analysis of derived service demands.

At the heart of any ITS is data collection. We need sensors and cameras installed along the highways to gather information about traffic flow, road conditions, and weather. These sensors can detect everything from vehicle speed and volume to road surface temperature and visibility. It's like giving our highways eyes and ears to monitor what's happening in real-time.

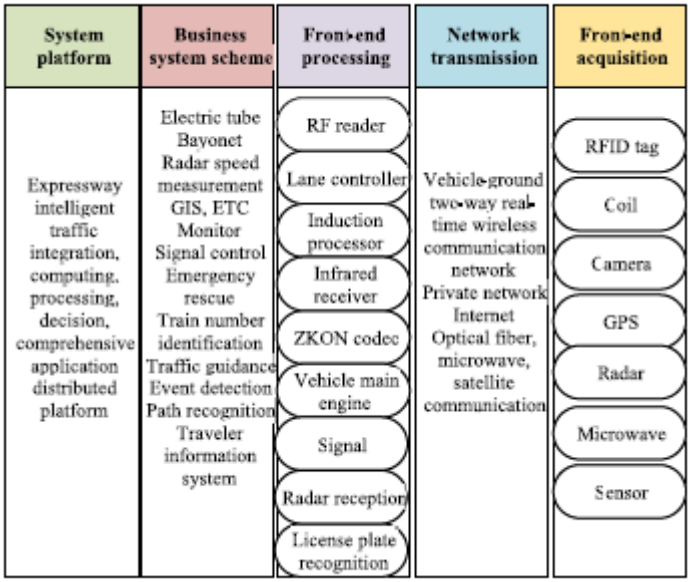

FIGURE 7. The overall architecture of intelligent highway transportation.

Once we have all this data, we need a way to transmit it to a central control center for analysis. That's where communication and connectivity come in. We can use wireless technologies like Wi-Fi or cellular networks to send data from the sensors to the control center. It's like creating a digital highway for information to flow seamlessly.

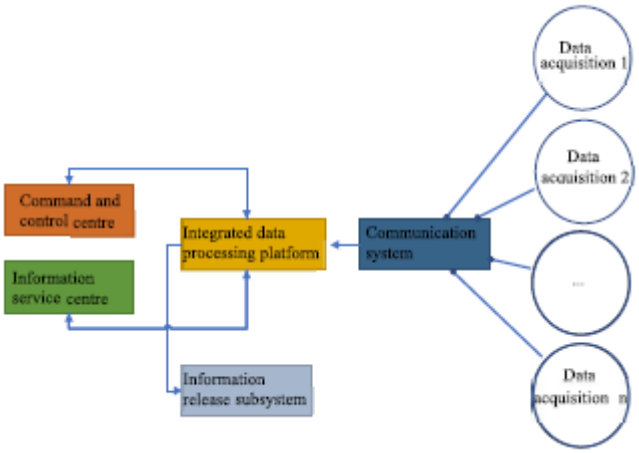

FIGURE 8. The network structure of ITS.

FIGURE 9. Hierarchical architecture of ITS.

At the control center, powerful computers crunch all the data collected from the sensors. They analyze traffic patterns, identify congestion hotspots, and even predict potential accidents before they happen. It's like having a super-smart brain that can make sense of all the information coming in and help us make informed decisions.

Based on the analysis of the data, the ITS can make real-time decisions to improve traffic flow and safety. For example, it can adjust traffic signal timings to reduce congestion or alert drivers to hazardous road conditions ahead. It's like having a virtual traffic manager that can optimize highway operations on the fly.

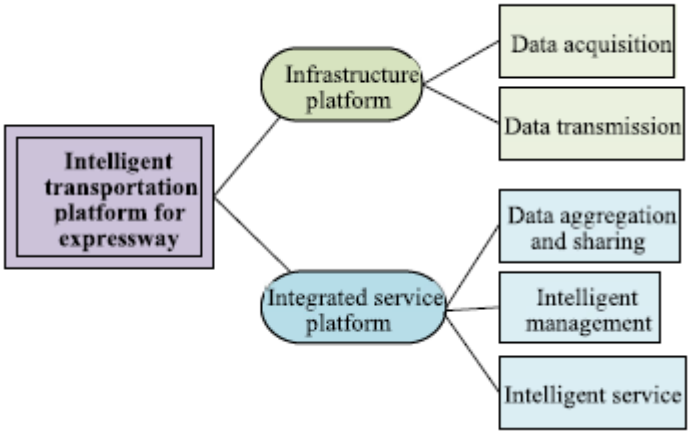

FIGURE 10. Framework model of expressway intelligent transportation platform.

One crucial aspect of ITS design is making it user-friendly for both transportation authorities and drivers. The control center needs intuitive software interfaces to monitor and manage highway operations effectively. Meanwhile, drivers should have access to real-time traffic information through digital signs, mobile apps, or in-car navigation systems. It's like designing interfaces that speak the language of both experts and everyday users.

Information Type	Electromechanical system	Information acquisition
Image information	Road and toll station monitoring system	Pavement condition Car condition Traffic flow operation status Meteorological information
Traffic flow information	Road and toll station monitoring system	Traffic Traffic density Vehicle speed Vehicle queue length
	Toll system	Vehicle type discrimination
Traffic environment information	Road monitoring system	Pavement condition
	Tunnel system	Brightness inside and outside the tunnel
	Road monitoring system	Bridge condition Slope condition
Traffic incident information	Road and toll station monitoring system	Traffic accident Vehicle breaks down Road construction
Traffic operation control data	Road and toll station monitoring system	Traffic incident response Variable information release and guidance Lane control
Vehicle charging data	Toll station monitoring system	Labor charge data Electronic charging data Vehicle license plate data

FIGURE 11. Traffic data collection table.

Finally, any good ITS design needs to be scalable and future-proof. As technology evolves and transportation needs change, the system should be able to adapt and grow without major overhaul. It's like building a highway that can handle more traffic and new features as they become available, ensuring its longevity and effectiveness for years to come.

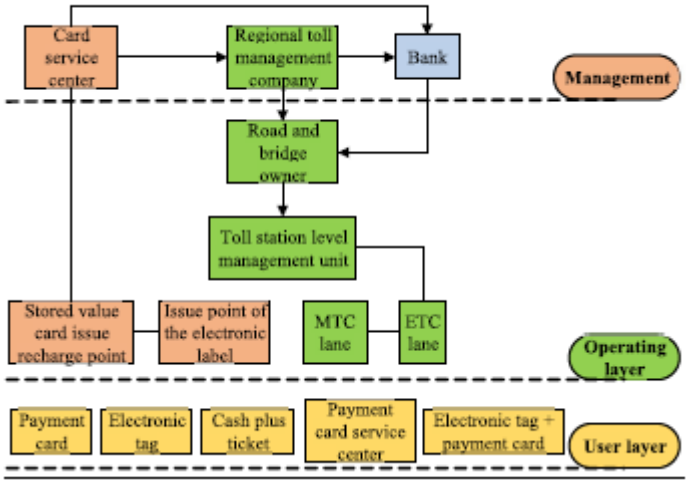

FIGURE 12. Operating framework diagram of the non-stop toll collection system.

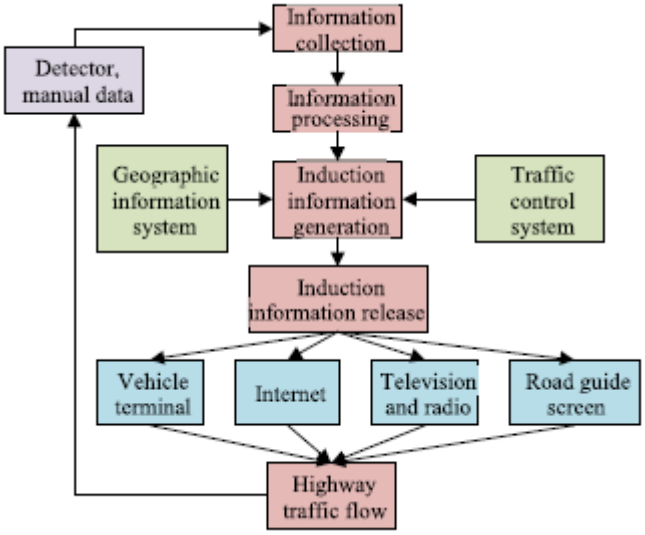

FIGURE 13. Traffic guidance flowchart.

SWOT Analysis Model:
Think of SWOT analysis like making a list of all the good and bad things about your project. It's like writing a pros and cons list for your homework assignment. By looking at the strengths, weaknesses, opportunities, and threats, you can figure out what you're doing well and what you need to improve on. It's like having a roadmap for success.

Strengths	Weaknesses	Opportunity	Threat
Large capital scale	Insufficient information openness	Policy opportunities	Incomplete information security
Low operational risk	Lack of uniform specifications	Green travel	Information leakage
Special fund support	Insufficient control	Increased environmental requirements	Public welfare of toll roads
Enhanced brand influence	The level of intelligent transportation needs to be improved	Active intelligent transportation market	Weak human resource base

FIGURE 14. Swot analysis of intelligent transportation.

Chapter 4

RESULTS

A. SWOT ANALYSIS AND COMPARISON

We used a method called SWOT analysis to understand the environment for intelligent transportation businesses. Here are the strategies we can choose:

- SO Strategy: When there are good things happening inside and outside opportunities, we should use both. We should follow good policies, use our strengths in intelligent transportation, and invest more in it.

- WO Strategy: If there are opportunities outside but weaknesses inside our business, we should use those outside chances to cover up our weaknesses. We should work better with government and improve how we manage things inside.

- ST Strategy: When we have strengths inside but threats outside, we should use our strengths to fight off those threats. We need to use what we're good at and connect our projects with smart cities.

- WT Strategy: If there are weaknesses inside and threats outside, we need to fix our weaknesses and avoid those threats. We should improve how we work and plan and understand government rules well.

B. COMPARISON OF HIGH-SPEED EMERGENCIES IN NEW ITS

We tested a new system for highways and compared it to how things were before:

- We found that we can get information much faster now, and the number of accidents decreased.

- Time spent in traffic jams reduced, and we could send maintenance workers quicker than before.

- Overall, dealing with emergencies is much better now than with the old system.

	Real-time information acquisition/hour	The number of traffic accidents/times	Road congestion time/hour	Highway facility maintenance efficiency/hour
Before use	0.5	75	45	Arrive within 1 hour
Intelligent transportation	0.16	38	30	Facility early warning system

FIGURE 15. Actual situation of different projects before and after use.

C. COMPARISON OF THE USE OF NEW ITS AND THE EXPERIENCE OF MANAGEMENT PERSONNEL

We asked people using and managing the new system how they felt about it:

- Users and managers liked the new system more than the old one.
- People generally prefer the new system for managing highway traffic.

FIGURE 16. Satisfaction of the user's experience before and after.

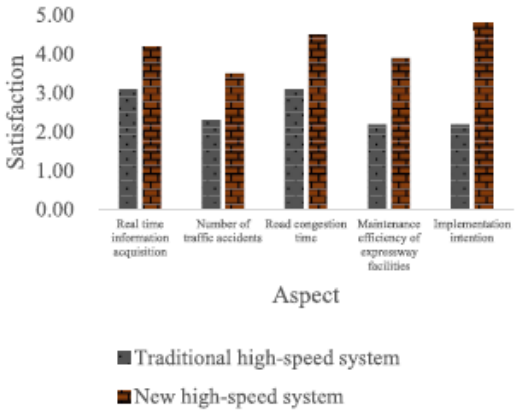

FIGURE 17. User intent survey

Chapter 5

CONCLUSION

Building intelligent highway transportation systems is crucial for making transportation smarter and more efficient. It greatly improves transportation efficiency, enhances safety, and boosts public confidence in the highway industry. This paper focused on enhancing the service capabilities of the highway industry by studying the necessity and importance of intelligent transportation.

The results demonstrate:

1. The maintenance management system's efficiency in handling emergencies before equipment failure is significantly higher than that of traditional methods.
2. User satisfaction with the updated system increases to 67%, and executive satisfaction rises to 78%, surpassing traditional traffic management methods.
3. Public expectations for implementing the innovative system are high, with an average expectation rating of 4.8 out of 5, indicating strong support for the proposed ITS.

This study systematically analyzed IoT and intelligent transportation technologies' characteristics, substance, and development processes. The designed highway ITS, based on IoT and AI, features advanced sensing technology, powerful information processing, and diverse terminal applications. It represents a breakthrough and exploration in IoT and intelligent transportation, aiming to play a proactive role in future

Chapter 6

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