Mini Project Report on

IOT hardware based Locomotive

Submitted by

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Under the guidance of

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DEPARTMENT OF COMPUTER ENGINEERING

SHAH AND ANCHOR KUTCHHI ENGINEERING COLLEGE

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Certificate

This is to certify that the report of the Mini Project entitled

"**IOT hardware based Locomotive**"

is a bonafide work of

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submitted to the

UNIVERSITY OF MUMBAI

during semester VI

in

COMPUTER ENGINEERING.

(Prof. Uday Bhave)

Guide

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Principal

Approval for Mini Project Report for T. E. Semester VI

This mini project report entitled “IOT hardware based locomotive” by Student 1, Student 2, and Student 3 is approved for the partial fulfillment of the requirement for the completion of Semester VI.

Name and Sign of Internal Examiner _____

Name and Sign of External Examiner _____

Date:

Place:

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Name of Student	Class	Roll No.	Signature
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Date:

Attendance Certificate

Date

To,
The Principal
Shah and Anchor Kutchhi
Engineering College, Chembur,
Mumbai-88

Subject: Confirmation of Attendance

Respected Sir,

This is to certify that Third year (TE) students
(Names of Students)

have duly attended the sessions on the day allotted to them during the period from _____to_____for performing the Mini Project titled _____.

They were punctual and regular in their attendance. Following is the detailed record of the student's attendance.

Attendance Record:

Date	Varad Potdar	Harsh Trivedi	Omkar Dalvi	Yash Ughade
	Present/Absent	Present/Absent	Present/Absent	Present/Absent
02/02/2022	Present	Present	Present	Present
09/02/2022	Present	Present	Present	Present
23/02/2022	Present	Present	Present	Present
02/03/2022	Present	Present	Present	Present
05/02/2022	Present	Present	Present	Present
24/03/2022	Present	Present	Present	Present
31/03/2022	Present	Present	Present	Present
1/04/2022	Present	Present	Present	Present
10/04/2022	Present	Present	Present	Present
14/04/2022	Present	Present	Present	Present

Signature and Name of Internal Guide

Abstract

Modern technology is beneficial in each and every part of our lives today. As a result, much progress in the realm of transportation has been made. In younger decades, crashes involving normal metro trains happened depending on a variety of factors, including operator mistake, signal failures, and other significant issues. The human-operated metro train has no time control, resulting in temporal inconsistency that impacts the railway network model. A novel design for a driverless metro train has been developed to address this issue. Driverless metro trains enhance the railway network's management system, decrease errors, use much less energy, and give travellers with more security and convenience while riding

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Chapter 1
Introduction

This study aims to learn about the technology behind the driverless metro train system, which is popular in industrialised nations such as Germany, Japan, and France [1]. It addresses both the issue of mass transit and the high cost of transportation in the metro rail system. It also cuts the metro train's energy usage by 30% [2] since it employs solar panels on the roof to power the train's accessories [5]. It also provides precise train timing control on station arrivals and departures [4]. A cpu unit, such as an Arduino controller, an 8051 processor, or PIC controllers, controls the functioning of the autonomous metro train [6]. The locomotive is designed to follow a predetermined course with a specified number of stops and a predetermined speed, which is controlled by the motor driver IC. The train's halt at stops is likewise predetermined. For train halting, RFID sensors and RFID tags are utilised [1]. Because the whole train operation is managed and conducted by a controller, the train does not require a driver or train attendant [7]. The main controller of the system in this study is an Arduino mega. The Arduino is in charge of the train's monitoring and performance. The train's many operations or tasks are carried out by downloading programmes from the Arduino using the Arduino IDE software. Other functionalities include LCD displays to give passengers messages, GSM-based SMS facility to know the train's position or location and send that information to the control centre via SMS service [8], alarms to give passengers indication for LCD messages as well as for indication of door operation, automatic door controlling, passenger counting section using IR modules [10], solar panels, MQ2 smoke sensor [9], vibration sensor [11], emergency mode [12], and emergency mode [13].

Chapter 2
Literature Survey

[1] In 2015, Trima P., Fernandese Fizardo, Egas Nunes, Yatish Naik, and Jesuslee Pereira released a paper on Smart Metro Train in which they presented a system that used a PIC Microcontroller to count passengers and generate warnings when compartments are full.

[2] In June 2015, X. Sun, S. Zhang, H. Dong, Y. Chen, and H. Zhu presented a study in which they used Lagrangian Duality Theory to solve a high-dimensional optimization problem.

[3] V. Sridhar submitted a study in 2012 that proposed a train announcement system that used speech IC and a radio frequency wireless card to track station data.

[4] A. Carteni, I. Henke, M. I. Di Bartholomeo, and M. Regna released a report in August 2019 demonstrating the major cost benefit of a fully Automated Driverless Metro, as well as an estimate of the project's high socioeconomic convenience.

[5] Bomdar Bagra1 and Vinay Kesharwani's article "Advanced Mechanized Metro Train" focused on passenger safety, therefore its prototype includes features like collision avoidance using an ultrasonic sensor and an AT-MEGA 328p as its basic unit. It also uses infrared sensors to check the temperature of the wheels. The train will stop and prevent any mishaps based on the information provided by these sensor systems. Its goal is to provide high levels of passenger safety in order to prevent a lot of deaths due to human error. The announcements on the radio station are totally automated.

[6] Premchand bharti1 and Ratneshpandey devised a metro train idea in which arrival stations are identified using IR sensors and automated door closure and opening is achieved. Two pairs of IR sensors monitor the number of passengers boarding and deboarding.

[7] Hemang Jani and Abhishek suggested a Driverless Metro Train in a paper titled "Driverless Metro Train," in which a PIC microcontroller is utilised to conduct the complete duty of a train without the aid of any driver inside. This involves the installation of an LCD panel for displaying the passenger count. It also aimed to reduce human mistakes, reduce power consumption, and give passengers with a comfortable and safe flight.

[8] A.P More and Monali Sarade [4] developed a smart metro train concept that is programmed using an ARM7 microcontroller in their article "Smart Metro train." It eliminates the need for any driver assistance in operating the train. This prototype includes an RFID ticketing module that

allows passengers to check if their card is valid and displays pertinent data on the LCD.

[9] Juanjuan Zhao and Fan Zhang proposed utilising Automated fare collection (AFC) to estimate how passenger movements are transmitted to various routes and trains in their article titled "Estimation of Passenger Route Choice Pattern Using Smart Card Data for Complex Metro Systems." Because the current system only works in specific conditions, this study will modify it to function in more complex ones. This model can predict how passenger flows are distributed over different routes and trains based on actual data.

[10] Igor Lopez and Javier Goikoetxea published a paper titled "Field experiments of an LTE-based wireless Train Backbone in metro settings," in which they constructed a wireless system in metro utilising LTE and antennas operating at 5.8G Hz, as well as the necessary tests using BOXPCS. Virtual coupling and train integrity are also involved. They also mentioned how the backbone's performance is influenced by reflections in the surroundings owing to the non-line-of-sight (NLOS) link between the antennas, as well as the restrictions of operating in the 5.8 GHz ISM band. Future stages for developing an operational train LTE backbone have been identified as a result of these testing.

[11] Parkash Ratan Tambare offered a plan to make train systems autonomous utilising the LPC2148 from the ARM7 family in a paper titled "Driverless Metro Train using ARM7." Station announcements and automated door closing and opening are included. It has plans for future improvements to metro train transit.

Chapter 3
Problem Definition

Driverless technology has the potential to increase timeliness while also lowering operational expenses. Consistent control of train speed profiles and increased capacity for traffic management measures to be implemented directly are two advantages of ATO. Automatic Train Operation (ATO) may enhance train speed, provide greater recovery from delays, and essentially increase capacity of the system. Automatic Train Operation also decreases human error and improves system safety.

Automatic Train Operation reduces energy consumption for a given journey time by controlling speed, which includes real-time optimization to account for delays. Sleeker acceleration adjustments compared to traditional control can extend the life of wheelsets and traction/braking equipment, as well as improve passenger comfort.

Automatic Train Operation can increase the number of trains, It can reduce the total fleet size, it can reduce the maximum rating of the electrical power supply system or major civil engineering structures, Driverless trains can increase capacity not just on the trains but also the routes because of its automation.

Objectives:

1. Better recovery from delays, essentially an increase in the capacity of the system.
2. Reduce human error, and increase the safety of the system.
3. Minimize energy consumption.
4. Increase the lifespan of wheelsets and traction/braking equipment.

PROPOSED METRO TRAIN SYSTEM	EXISTING METRO TRAIN SYSTEM
▪ Fully Automated	▪ Semi Automated
▪ A system for checking capacity of a coach is developed.	▪ There is no system to check coach capacity.
▪ Single card can be used for multi-ticketing purpose.	▪ Single card cannot be used for multi-ticketing purpose.
▪ Solar energy and piezoelectric energy sources are used to run the train.	▪ Electricity is used to run the train which is expensive.
▪ Automated station's announcements, door opening and closing can be done by using Arduino also display it on LCD.	▪ Station's announcements, door closing and opening system are controlled by the driver.
▪ RFID Tags, Smoke Detector, GSM SMS service to track the train and Emergency Braking Buttons are also included.	▪ No such sensors are used apart from Emergency Braking Lever.

Table 1.1: Comparative Analysis

Chapter 4
Implementation Details

The main controller in this project is an Arduino Nano. A source of 5V for the Arduino is provided via a power bank. The Arduino is linked to all of the components that are employed in the train's various operations. Initially, the train will obtain supplies from a source and prepare to move. The motor driver IC and door motor were powered by a 12V battery in this case. However, the LCD will first display the message "The train will depart from the station in a few minutes." Every LCD message and door operation triggers the buzzer.

The passenger counting portion was activated, and it used IR modules to count the passengers and display the results on the LCD. The LCD will then display the words "Doors are shutting" along with a buzzer. The train starts moving and departs from the station when the motor status is changed from off to on.

The LCD will display the message "Train is arriving on the station in few minutes" with buzzer functioning when the train arrives at the station. Using RFID sensors and RFID tags, the status of the motor switches from on to off.

The train has an RFID sensor, and RFID tags are placed at the stop. The train's motors are switched from on to off when RFID tags are detected by the RFID sensor. The message "The doors are opening" will appear on the LCD, and the door control will open the door. During the train's operation, the whole departure and arrival process is repeated at each stop.

It also has some extra capabilities, such as a GSM-based SMS service that can be used to track the train's location and communicate data to the control centre.

This train has a solar panel on top that powers the train's auxiliary such as LCD screens, mobile charging outlets, lights, and fans. The inverters may transform the generated solar electricity into AC power based on the requirements. The train's electricity usage is reduced because to the installation of solar panels.

For protection, it also contains smoke detection through the MQ2 smoke sensor. When there is an issue in the train, such as a system failure or an electric shock, smoke is formed, which the smoke sensor detects and sends a signal to the Arduino for train protection.

It safeguards the train from fire as well as short circuits.

It also has a train-mounted emergency braking button. It is used to apply brakes to the train in an emergency. A vibration sensor is also included for safety purposes. When an emergency arises in the train due to any form of breakdown, vibration occurs, which is detected by the vibration sensor and signals the control system by GSM facility.

The system may be hacked, and the destination can be modified, putting passengers' lives in peril. This automation was previously implemented using PIC microcontrollers, but today we have Raspberry Pi and Arduino.

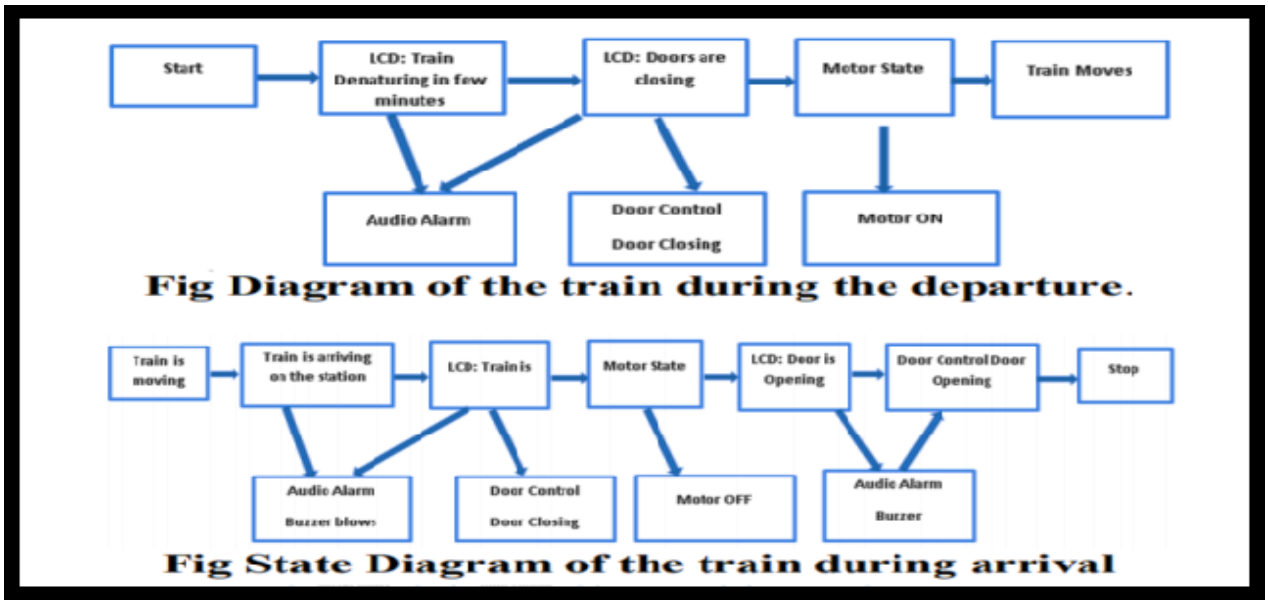

Figure 1.1 Train arrival and departure flowchart.

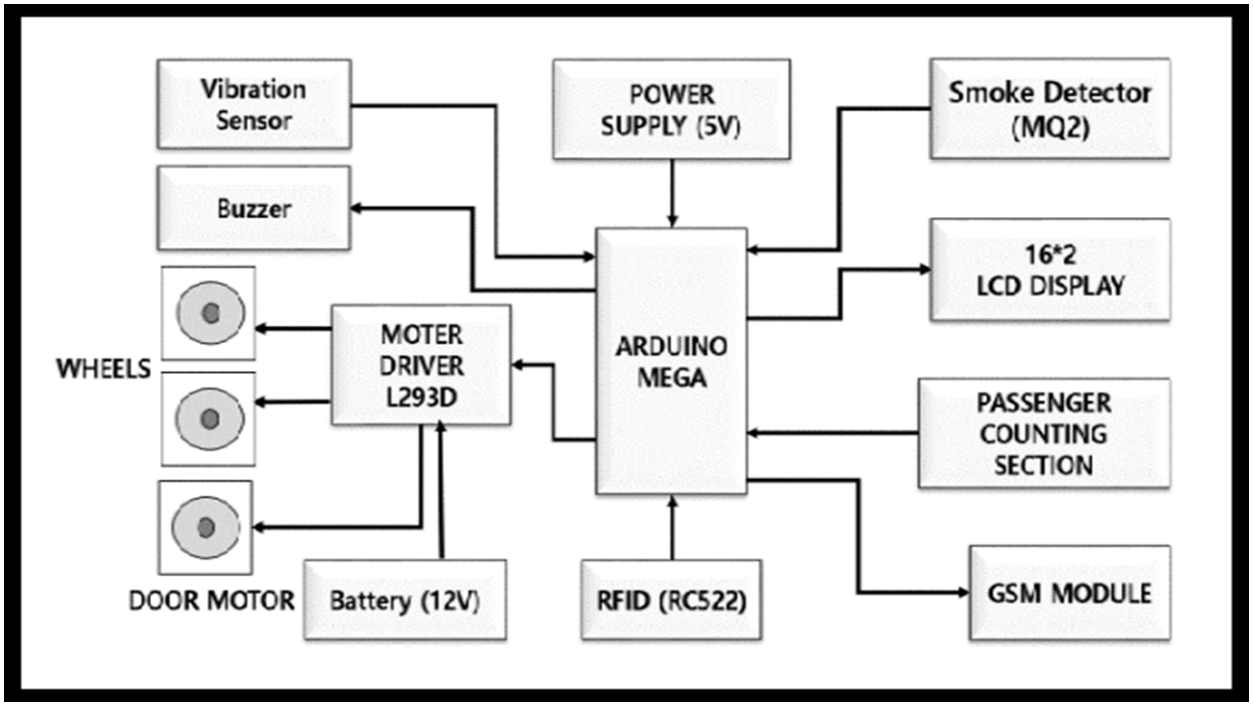

Figure 1.2 Modeling and Simulation flowchart

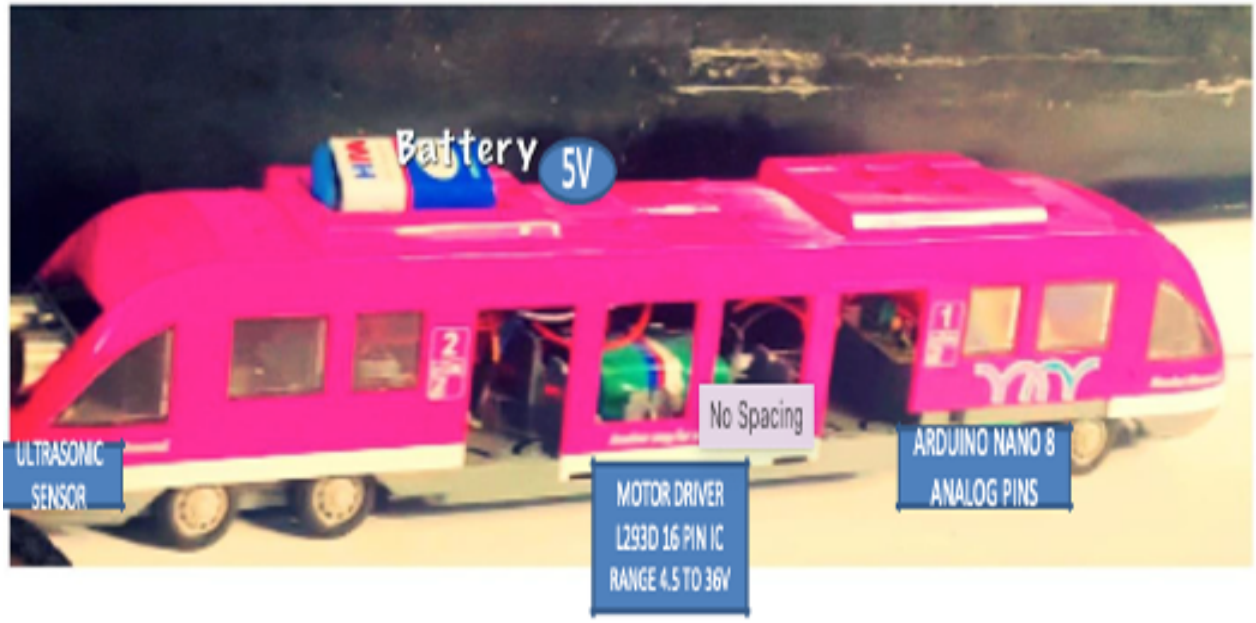

Figure 1.3 Implementation.

Chapter 5
Result and Analysis

The IR line is interrupted once the train reaches a station, and the train automatically stops. After the train has come to a complete stop, the doors will be opened and a buzzer will sound to alert passengers that the station has arrived.

Meanwhile, the passenger counting section will count the number of people on board and show the information on an LCD screen. A buzzer will sound and the doors will close automatically once the timer on the controller has expired. A buzzer will sound and the doors will close automatically once the timer on the controller has expired.

The need for greater service, tracking variations in passenger demand, and tracking on-time performance concerns are the main service issues revealed by passenger counting technologies. Auto Metro uses AVL to improve traffic management efficiency and customer service information.

ATS and AVL, in particular, aid in determining what concerns need to be addressed. Monitoring technology, when combined with human employee monitoring, enable transportation companies to deliver more efficient and effective service. In Metro, preventative maintenance equipment, together with service monitoring, increases service dependability. Service monitoring technology's accuracy and volume of data must be addressed. Monitoring technology, when combined with human employee monitoring, enable transportation companies to deliver more efficient and effective service.

Chapter 6
Conclusion

Problems still remain in the present system, however they can be improved in the following ways:

Because the effectiveness of solar panels decreases on cloudy or rainy days, as well as at night, a large inverter or battery should be utilised to store and consume the power when practical.

Hackers gaining access to the vehicle's software and manipulating or changing its functioning would be a big security concern, and to avoid such crimes, a strong encryption programme and firewall would be necessary.

Lastly, all these systems will send data to an operator which will live track all this data and he will be aware of all the situations and give commands to Arduino (controller) of what is to be done.

Finally, all of these systems will provide data to an operator who will monitor the data in real time, be aware of all of the conditions, and issue commands to the Arduino (controller).

This approach makes it easier to develop smart cities and give better metro train services to the general public. Our driverless metro train concept has certain unique advantages, such as completely autonomous driverless operation with reduced travel time, lower power use, and smoke detection. A driverless metro system delivers higher service quality and precise train arrival and departure times. It lowers the system's total operating costs and minimises the train's power usage by using solar panels. This method has the benefit of transporting more passengers than regular metro train services.

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