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POLYTECHNIC

KENNEDY ROAD, PUNE – 01

DEPARTMENT OF MECHANICAL ENGINEERING
(2025-2026)

A CAPSTONE PROJECT REPORT

ON

“RAILWAY ACCIDENT MITIGATION SYSTEM”

PROGRAM CODE : ME-6 I

COURSE NAME - CODE : CAPSTONE PROJECT - 22060

BY

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UNDER THE GUIDANCE OF

Mr.

AISSMS

POLYTECHNIC

CENTER OF ACADEMIC EXCELLENCE

Approved by AICTE New Delhi, Recognized by the Government of Maharashtra
and Affiliated to MSBTE, Mumbai
Institute Code: **6415**

DEPARTMENT OF MECHANICAL ENGINEERING

VISION AND MISSION OF THE INSTITUTE

- **VISION**

  Achieve excellence in quality technical education by imparting knowledge, skills and abilities to build a better technocrat.

- **MISSION**

  M1 : Empower the students by inculcating various technical and soft skills.

  M2 : Upgrade teaching-learning process and industry-institute interaction continuously.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION AND MISSION

- **VISION**

Create competent mechanical engineering with good humanities, leadership and entrepreneurship qualities for Global Development.

- **MISSION**

M1 : To impact quality education through demanding academic programme.

M2 : To increase employability through Industrial interaction and Entrepreneurship Development.

M3 : To enhance technical skills and social awareness.

PROGRAM OUTCOMES (POs)

PO1 Basic knowledge: An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.

PO2 Discipline knowledge: An ability to apply discipline – specific knowledge to solve core and/or applied engineering problems.

PO3 Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

PO4 Engineering Tools: Apply appropriate technologies and tools with an understanding of the limitations.

PO5 The engineer and society: Demonstrate knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.

PO6 Environment and sustainability: Understand the impact of the engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.

PO7 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO8 Individual and team work: Function effectively as an individual, and as a member or leader in diverse/multidisciplinary teams.

PO9 Communication: An ability to communicate effectively.

PO10 Life-long learning: Recognize the need for, and have the preparation and ability

to engage in Independent and life-long learning in the context of technological changes.

PROGRAM SPECIFIC OUTCOMES (PSO)

The Diploma in Mechanical Engineering will prepare students to attain :

PSO 1 : Empowerment with knowledge of mechanical engineering activities with scientific approach.

PSO 2 : Development with technical skills for updating industrial atmosphere and entrepreneurship qualities.

Sr. No	Project Name	Name of Guide	POs										PSOs	
			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
1	ELECTRONIC SOLAR BIKE	Mr. S. C. CHIKURDE												

CO-PO-PSO-Mapping (2025-26)

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CERTIFICATE

This is to certify that …, from **AISSMS Polytechnic, Pune-01 affiliated to MSBTE, Mumbai** has completed **Final Project Report** in six semester, during academic year 2024-25. Having title **"RAILWAY ACCIDENT MITIGATION SYSTEM"** in a group consisting of four persons under the guidance of the Faculty Guide.

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Team members

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Dhavale ketaki

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Ladkat Arya

ABSTRACT

The Railway accident mitigation system is a comprehensive solution aimed at modernizing railway infrastructure to improve safety, efficiency, and passenger convenience. This project integrates multiple smart features including automated smart gates, real-time obstacle detection, and an intelligent collapsible bridge system.The smart gates automatically operate based on train schedules and sensor data, preventing unauthorized access to tracks and significantly reducing accidents at level crossings. The obstacle detection system, using ultrasonic or infrared sensors and cameras, identifies the presence of vehicles, humans, or other objects on the track and triggers alerts or emergency train halts, ensuring enhanced safety for both pedestrians and trains.

A key innovation is the collapsible bridge between platforms, designed to provide a direct and effortless route for passengers to cross platforms. The bridge remains accessible during normal operations and automatically retracts or lifts when a train approaches or departs, ensuring zero interference with train movement while avoiding the need for long detours or unsafe crossing practices.

Furthermore, the system supports semi-autonomous train operation, where sensor-driven data assists in speed control, braking, and emergency responses. Combining IoT, embedded systems, and automated control technologies, the Railway accident mitigation system envisions a future where railway travel is safer, smarter, and more user-friendly for all.

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CHAPTER 1

INTRODUCTION AND BACKGROUND

RAILWAY ACCIDENT MITIGATION SYSTEM

1.1 Idea of Project

Railways play a vital role in the socio-economic development of a country by offering a cost-effective and reliable mode of transportation for both passengers and goods. However, despite technological advancements in other domains, many railway systems still operate with outdated safety mechanisms, inefficient passenger movement systems, and limited automation. These shortcomings often lead to accidents at level crossings, time delays, platform overcrowding, and poor accessibility, especially for elderly and disabled passengers.

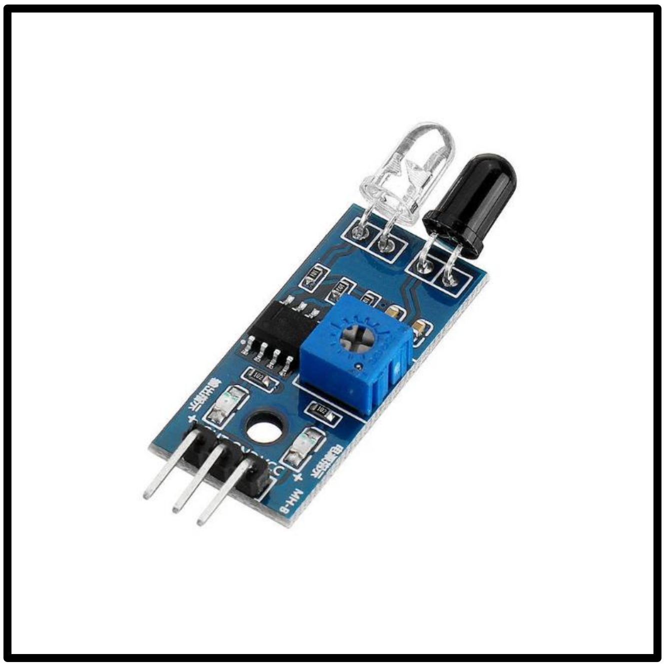
The Railway accident mitigation system is a next-generation solution aimed at modernizing railway infrastructure by integrating smart technologies, automated mechanisms, and intelligent sensing systems. The goal is to enhance operational safety, passenger convenience, and system efficiency.

Fig 1 Indian Railways

1.2 Brief descriptions

One of the core components of this system is the automated smart gate. Traditional manually operated or unattended gates are a major cause of railway accidents. In our system, gates are automated and controlled using real-time train tracking data and sensor inputs. These gates open and close autonomously, minimizing the risk of accidents by ensuring no pedestrian or vehicle is on the tracks during train movement.

Another major innovation is the real-time obstacle detection system. Utilizing ultrasonic, infrared, or LIDAR sensors, the system continuously monitors the track for any unexpected objects, people, or animals. When an obstacle is detected, the system sends immediate alerts to the control center and the approaching train, enabling emergency braking or diversion measures to avoid collisions.



1.2.1 Fig 2 IR sensor

1.2.2 Fig 3 Ultrasonic sensor

To address the inconvenience faced by passengers while crossing platforms, we introduce a collapsible bridge that connects two or more platforms. This bridge remains extended during idle periods, allowing passengers to cross easily without using distant footbridges or unsafe shortcuts. As soon as a train approaches, the bridge automatically retracts or elevates, ensuring it does not interfere with train operations. This not only reduces platform crowding but also improves accessibility, especially for those with limited mobility.

Fig 4 Railway crossing

Furthermore, the Railway accident mitigation system leverages IoT and embedded control units to manage data from sensors, control actuators (like gates and bridges), and provide live monitoring and analytics through a centralized dashboard. The system is also scalable and can be integrated with semi-autonomous train controls, making it adaptable for future advancements in railway automation.

By implementing this system, we aim to reduce human error, increase safety, and provide a seamless travel experience. The Railway accident mitigation system demonstrates how the fusion of electronics, automation, and communication technologies can revolutionize public transportation for safer and smarter cities.

CHAPTER 2

LITERATURE SURVEY FOR PROBLEM IDENTIFICATION

2.1 Survey for problem Identification

Railway systems across the world have evolved significantly in terms of speed and coverage, but safety and efficiency at the platform level and level crossings continue to be critical concerns, especially in densely populated or rural areas. A review of existing research and real-world case studies reveals several recurring problems that highlight the need for smart, automated solutions in railway infrastructure.

2.1.1. Accidents at Unmanned Railway Crossings

According to multiple government and NGO reports, a large percentage of railway accidents in countries like India occur at unmanned level crossings. Studies such as “Safety Challenges at Indian Railway Crossings” (IRCTC Journal, 2020) have shown that lack of automated gate control and real-time alerts lead to fatal collisions involving vehicles, pedestrians, and incoming trains.

2.1.2. Inefficiency in Platform Navigation

Research published in the "International Journal of Transport and Safety Engineering" (2019) emphasizes that passenger inconvenience due to long detours or the lack of direct platform-to-platform connectivity often leads to risky behavior, such as crossing tracks illegally. This is especially hazardous for the elderly, disabled, or people carrying luggage.

2.1.3. Lack of Real-Time Obstacle Detection

Traditional railway systems lack the ability to detect unexpected obstacles on tracks in real-time. In the paper "Intelligent Obstacle Detection for Railway Safety" (IEEE, 2021), it was concluded that many train collisions could have been avoided with real-time object detection using ultrasonic or LIDAR-based sensing systems.

2.1.4. Manual and Delayed Gate Operations

A study on smart transport systems in the Journal of Smart Infrastructure Systems (2022) highlighted that manual gate operation is prone to human error and delay. Automation of gates using real-time train location data and wireless control significantly improves safety and system reliability.

2.1.5. Lack of Smart Integration in Current Railway Systems

Despite advancements in high-speed rail and digital signaling, platform-level smart systems like collapsible bridges or automated pedestrian gates are rarely implemented. According to a UN report on sustainable smart cities (2022), integrating IoT and embedded systems in public infrastructure can lead to major safety and efficiency improvements, especially in transit hubs like railway stations.

2.1.6. Case Studies on Smart Gate Systems

Several pilot projects, such as Japan's use of AI-powered smart gates and Germany's smart railway crossings, have demonstrated significant reductions in accidents and improved operational efficiency. These global examples show the viability and need for localized, scalable smart railway solutions.

2.2 Problem Identification Summary

1. Based on the literature reviewed, the key problems identified are:
2. Frequent accidents due to unmanned or poorly operated gates.
3. Risky platform crossing due to the absence of safe, accessible routes.
4. Lack of obstacle detection systems to prevent track-related accidents.
5. Inadequate automation in pedestrian and train interaction zones.

CHAPTER 3

PROPOSED METHODOLOGY WITH AN ACTION PLAN

3.1 Problem definition and scope

The Railway accident mitigation system aims to implement a multi-functional, automated railway safety and accessibility solution that enhances both operational safety and passenger convenience. The system combines sensor networks, embedded systems, and mechanical automation to solve existing problems in traditional railway infrastructure.

3.2 Project Plan

3.2.1 Smart Gate Control System

1. Automated gates at railway crossings using IR sensors to detect approaching trains.
2. The output of IR sensor is always high when there is no obstacle detected, it becomes low when an obstacle is detected.
3. This can be easily read by a microcontroller to open and close gate when train arrives and departs from post gates
4. Gates controlled by SG90 servo motors. These servo motors are operating on 1-2ms PWM pulse width which is given by respective microcontroller used.
5. 4 IR sensors and 3 servo motors are used in this project.
6. The microcontroller also sets traffic signal as RED[stop] or GREEN[go] based on sensors readings.

3.2.1 Obstacle Detection Mechanism

1. For obstacle detection we have used IR sensors in front of train to detect any obstacle like person or some foreign object in tracks. This sensor is also used for stooping train right at the railway station before the collapsible bridge

2. The electronics in train includes Arduino UNO (microcontroller), Motor driver l293D and BO motors for propulsion.

3.2.3 Collapsible Bridge Between Platforms

1. A mechanically operated bridge between platforms for easy crossing.
2. The bridge is controlled using servo motor and used for connecting platforms when train is not moving.
3. This system can help elderly and disabled people which have difficulty in walking on long crossover bridges.

3.2.4 Central Control Unit

1. Arduino UNO was used as computing unit in this project. It has atmega 328p microcontroller as processing unit.
2. Specifications:

- Operating Voltage: 1.8V – 5.5V (Typically 5V for most applications, particularly in Arduino projects)
- CPU Speed: Up to 20 MHz
- Flash Memory: 32 KB
- SRAM: 2 KB
- EEPROM: 1 KB
- Number of I/O Pins: 23
- Analog-to-Digital Converter (ADC): 6 channels with 10-bit resolution
- PWM Channels: 6 (Pins 3, 5, 6, 9, 10, and 11)
- Timers/Counters: Three 8-bit and one 16-bit timer
- Communication Interfaces: USART, SPI, I2C (TWI)
- Power-Saving Modes: Idle, ADC Noise Reduction, Power-down, Power-save, Standby, and Extended Standby

3.2.5 Power Backup and Safety Systems

The entire prototype is power bank powered (5V) and solar panels can also be used with bus stand to make it green energy sustainable.

3.2.6 Software part/coding:

Totally 2 Arduino UNO's were used in this project and to code them we have used Arduino IDE tool.
The both were connected to laptop with software installed and code was uploaded into them for testing.
In initial phase of project, all the circuit were prototype on breadboards and Arduino code was checked for each to ensure proper functionality in entire project upon assembly.

<u>Smart Railway Station Code:</u>

```
#include <Servo.h>
#include <LCD_I2C.h>
#include <Wire.h>
#include<avr/wdt.h>

Servo s1;
Servo s2;
Servo s3;
unsigned long presentime;
const long duration = 400;
unsigned long prevtime = 0;
unsigned long prevtime1 = 0;

LCD_I2C lcd(0x27, 16, 2);

const int redlight = 3;
const int greenlight = 4;
const int servopin1 = 5;
const int servopin2 = 6;
const int servopin3 = 10;
```

```
bool train_arrived = false;
bool previousstate=1;
bool red_led_state=0;
bool green_led_state=1;
void setup()
{



  pinMode(8, INPUT);
  pinMode(7, INPUT);
  pinMode(redlight, OUTPUT);
  pinMode(greenlight, OUTPUT);
  s1.attach(servopin1);
  s2.attach(servopin2);
  s3.attach(servopin3);
  Wire.begin();
  lcd.begin(&Wire);
  lcd.backlight();
  s1.write(0);
  s2.write(0);
  digitalWrite(greenlight, HIGH);
  s3.write(0);

}

void loop()
{
  presentime = millis();

  bool red = digitalRead(7);
  bool green = digitalRead(8);


  if (red == 0)
  {
    s1.write(90);
    s2.write(90);
  }
```

```
if(red==0||green==0)
{
   red_led_state=!red_led_state;
   green_led_state=!green_led_state;

   digitalWrite(redlight, red_led_state? HIGH:LOW);

   digitalWrite(greenlight, !green_led_state? LOW:HIGH);
    delay(200);
}


if (green == 0)
{
  train_arrived = true;
  s1.write(0);
  s2.write(0);
  prevtime1 = millis();
}


if (train_arrived)
{
  lcd.setCursor(15, 0);
  lcd.print(F("PUNE DAUND EXPRESS"));
  lcd.setCursor(15, 1);
  lcd.print(F("PLATFORM NO.3"));

  if (presentime - prevtime >= duration)
  {
    lcd.scrollDisplayLeft();
    prevtime = presentime;
  }

  if (millis() - prevtime1 >= 10000)
  {

    s3.write(140);
```

```
    }
     if (millis() - prevtime1 >= 15000)
    {

      s3.write(0);
      void(* resetFunc) (void) = 0;
      resetFunc();

    }
  }
}
```

Smart Train Code:

```
const int duration=500;
unsigned long prevmillis = 0;


void irsensor1(int pin1)
{
  unsigned long starttime=millis();

  bool value = digitalRead(pin1);

  if(!value)
  {
    analogWrite(9,0);
    analogWrite(10,0);
  }
  else
  {
    if(starttime - prevmillis == duration)
    {
    analogWrite(9,130);
    analogWrite(10,130);
```

```
    }
    else
    {
      prevmillis=starttime;
      analogWrite(9,170);
    analogWrite(10,170);
    }


  }


void setup() {

  pinMode(10,OUTPUT);
  pinMode(9,OUTPUT);
  pinMode(11,OUTPUT);
  pinMode(12,OUTPUT);
  pinMode(6,INPUT);
  pinMode(7,INPUT);
  digitalWrite(11,HIGH);
  digitalWrite(12,HIGH);
  Serial.begin(9600);
}

void loop() {
  irsensor1(6);
}
```

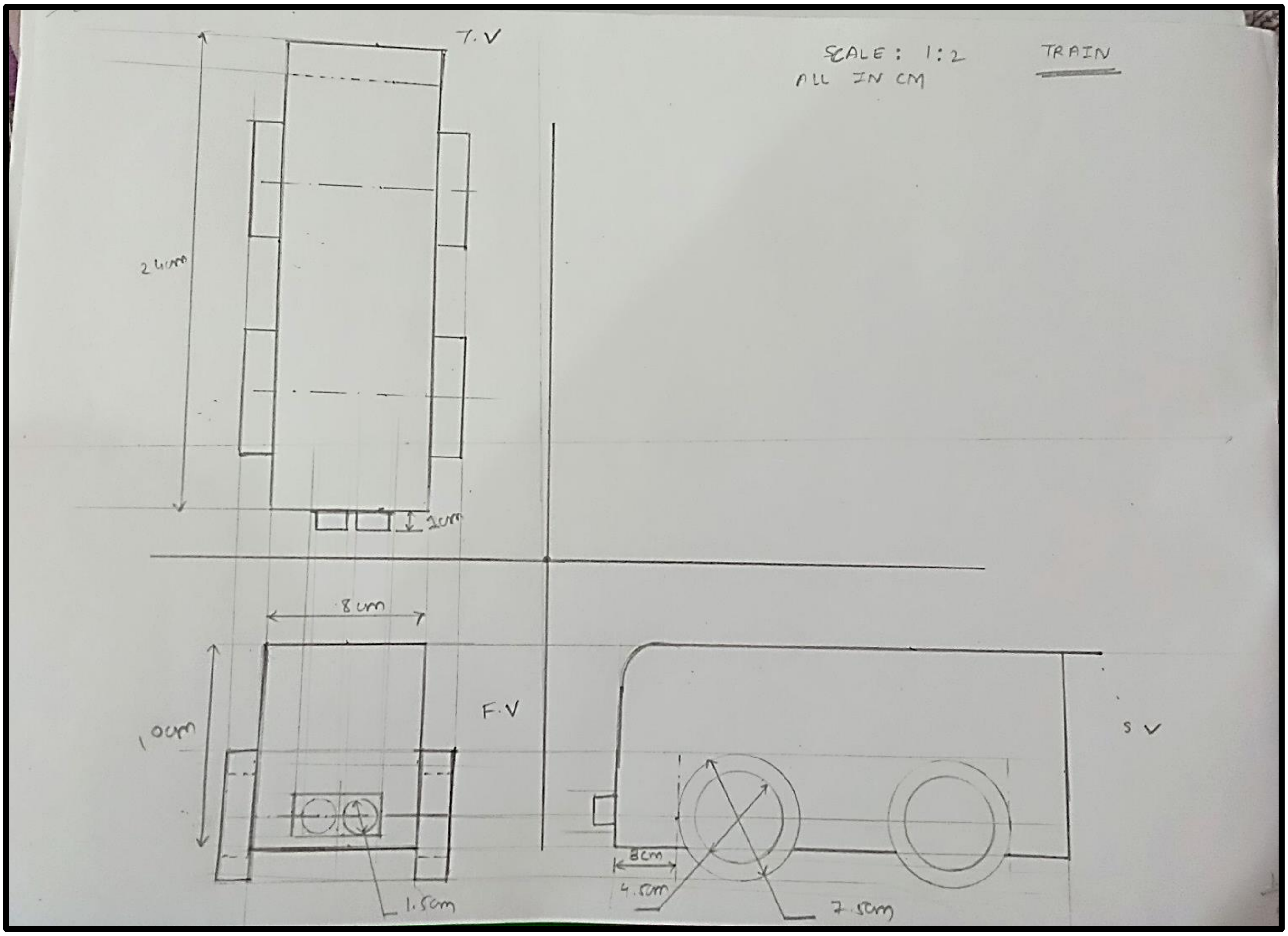
3.3 Equipment's / Parts-requirement / Specification (BOM)

Sr No.	Name of component/Material	Specification	Quantity	Price(Rs)
1	IR sensor	Optical avoidance	4	120
2	Arduino UNO R3	Dip package	2	600
3	Servo motor	SG90	3	300
4	LED	Diffused Red, Green, Yellow	4 x red 4 x green 4 x yellow	12
5	Motor Driver	L293D	1	80
6	DC Motors	Geared BO motors	4	280
7	BO motor wheels	Diameter:65mm	4	140
8	Jumper wires	Male-to-male	1 set	40
9	Switch	SPST	1	10
10	Wire	0.5 sqmm	2m	60
11	Foam board	3' x 3'	1	300
12	Wooden Board	Hard wood 38.5' x 9.5'	1	400
13	flexquick	Pidilite industries ltd	1	60
14	fevobond	25gm	1	30
15	USB cable	-	1	100

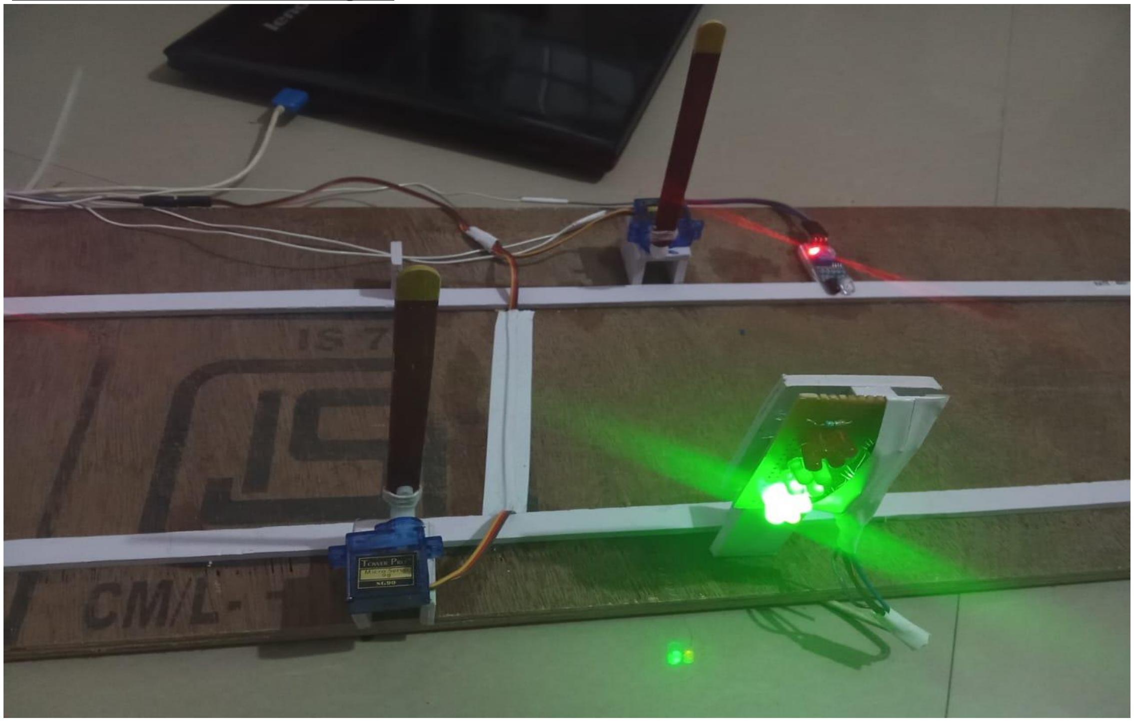
16	Li ion rechargeable cells	18650 2000mah	4	400
17	18650 2s battery holder	-	2	100
18	Charging module	Tp4050	2	100
19	Cell holder	18650	1	30
20	LCD 16 x 2	Liquid crystal display(blue)	1	150
21	GPS module	Neo 6m	1	250
Total material costing for project:				3562

3.4 Project related Drawings

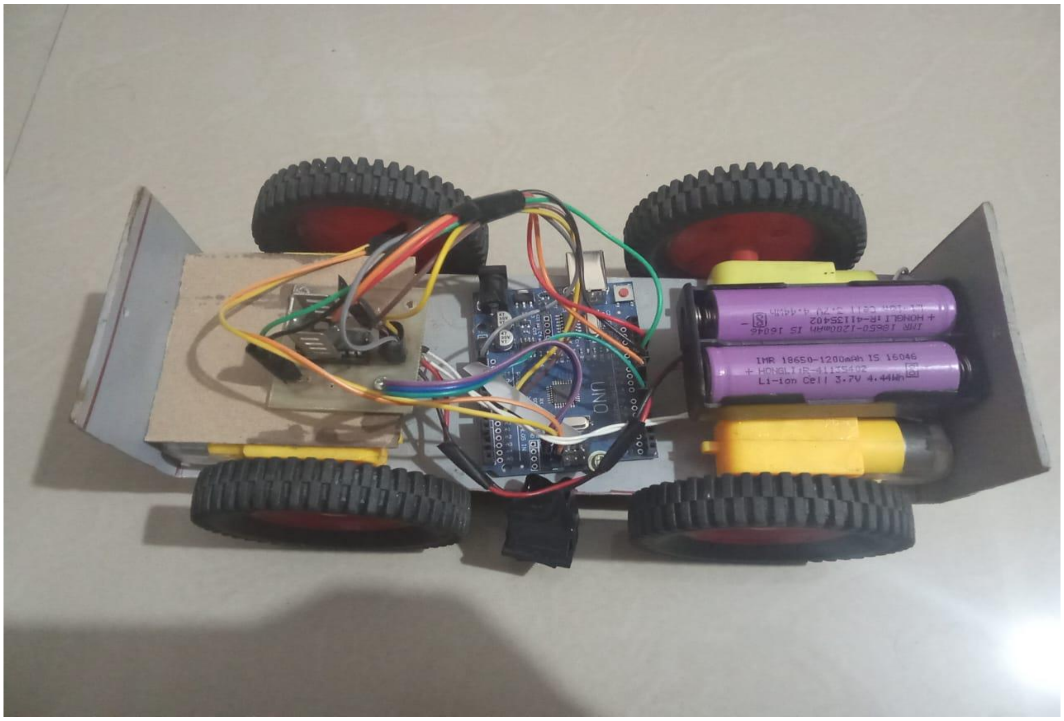
3.4.1 Fig 5 Orthographic drawing train body



3.5 Project related images



3.5.1 Fig 6 Smart railway gates



3.5.2 Fig 7 Train electronics

3.5.3 Fig 8 Scrolling LCD

CHAPTER 4

IMPLEMENTATION

4.1 Implementation

The implementation of the Railway accident mitigation system involves the integration of hardware and software components to create a fully functional prototype that demonstrates smart gate control, obstacle detection, and a collapsible platform bridge. The development process is modular, allowing each part to be tested individually before full system integration.

4.1.1. Smart Gate Control System

Objective: Prevent unauthorized access to the railway track by automatically operating the gate based on train presence.

Components Used:

- IR sensors or ultrasonic sensors for train detection
- Servo motor for gate movement
- Arduino/STM32 microcontroller
- Buzzer and LED indicators

Process:

1. Place IR sensors on both sides of the railway track to detect approaching and departing trains.
2. When a train is detected, the microcontroller receives input and activates the servo motor to close the gate.
3. Buzzer and LEDs are activated to warn pedestrians and vehicles.
4. After the train passes, the gate reopens automatically.

4.1.2. Obstacle Detection System

Objective: Detect any obstacle (human, animal, or vehicle) on the track and alert the system in real-time.

Components Used:

- IR sensor
- Microcontroller: Arduino UNO
- L293D driver
- BO motors
- BO motor wheels
- Buzzer or alert system

Process:

1. The sensor is positioned to monitor the track area continuously.
2. If an object is detected within a certain threshold distance, the microcontroller processes the signal.
3. It stops the train immediately and alerts via buzzer.

4.1.3. Collapsible Inter-Platform Bridge

Objective: Enable passengers to cross platforms directly and safely when no train is present.

Components Used:

- Servo motor SG90
- IR sensor to detect train proximity
- Microcontroller: Arduino UNO
- Mechanical bridge model (collapsible)

Process:

1. The bridge remains extended between platforms during idle times.
2. IR sensors detect the approach of a train.
3. Upon detection, the microcontroller signals the actuator to retract or lift the bridge automatically.
4. Once the train has passed safely, the bridge is redeployed for pedestrian use.

4.1.4. Central Control Unit and Monitoring

Objective: Coordinate all subsystems and allow centralized control and monitoring.

Components Used:

- Arduino UNO
- 16 x 2 LCD
- Power management system (battery or solar-powered backup)

Process:

1. In the smart railway station, Arduino UNO has been used to central computing.
2. If train as per schedule is available it will automatically display it name and platform on scrolling LCD display making passengers aware that train has arrived.

4.1.5. Testing & Calibration

1. Each module is tested independently to ensure functionality.
2. Sensor thresholds (e.g., obstacle distance, train detection range) are fine-tuned.
3. Safety checks and fallback options (manual override switches, emergency stops) are implemented.

4.2 Specification of components used

1. **IR sensor**

Item Type: Sensor

Model Type: Sensor Module

Operating Voltage (V): 3.6 to 5

Main Chip: LM393

Avg. Current Used (mA): 0.06

Detection Angle: 35°

Distance Measure (cm): 2 ~ 30

Dimensions (L x W x H) mm: 48 × 14 × 8

Weight (g): 5

Shipping Weight: 0.01 kg

Shipping Dimensions: 5 × 4 × 1 cm

2. **Arduino UNO R3**

Input Voltage (V): 6–20V

Analog I/O Pins: 6

Digital I/O Pins: 14 (of which 6 provide PWM output)

PWM Digital I/O Pins: 6

DC Current per I/O Pin (mA): 40

DC Current for 3.3V Pin (mA): 50

Clock Speed: 16 MHz

SRAM: 2

EEPROM: 1 KB (ATmega328)

Flash Memory: 32 KB

Dimensions (L × W × H) mm: 75 × 54 × 12

Weight (g): 28 (without cable), 54 (with cable)

Shipping Weight: 0.08 kg

3. **Servo motor SG90**

Item Type: Digital Servo Motor

Manufacturer: ACEBOTT

Operating Voltage: 3.3V~5V

Operating Temperature (°C): -30 – 60

Control Signal: PWM signal

Torque: 1.6KG/cm

Shipping Weight: 0.025 kg

Shipping Dimensions: 11 × 5 × 3 cm

4. **LCD 16 x 2 with I2C**

Model Type: Original JHD LCD

Display: 16×2 Character

Backlight Color: Blue

Characters: 16

Character Color: White

Input Voltage (V): 5

Length (mm): 80

Width (mm): 36

Height (mm): 14.5

Weight (g): 30

Shipping Weight: 0.033 kg

Shipping Dimensions: 9 × 5 × 1 cm

5. **L293D**

Current Rating (A): 0.6

Voltage Rating (V): 4.5 to 12

Driver Model: L293D

Operating Voltage (VDC): 4.5 ~ 12

Peak Current (A): 0.6

No. of Channels: 1

Cooling Fan (Y/N): No

Arduino Shield (Y/N): can be used with Wire connection, No

Polarity Protection (Y/N): NO

Dimensions (L × W × H) mm: 48 × 34 × 14

Weight (g): 15

6. <u>BO motor</u>

Rated Voltage (VDC): 3 to 12

Rated Speed (RPM): 60

Rated Torque (kg-cm): 1

No Load Current (mA): 40–180mA

Weight (g): 30

Dimensions (L × W × H) mm: 70 × 22 × 18

7. <u>LED</u>

Manufacturer: Generic

Wavelength (nm): 635

Forward Voltage (V): 1.63 to 2.03

Viewing Angle (Deg.): 16

LED Brightness (MCD): 4500

Mounting Type: Through Hole

Diameter (mm): 5

Weight (g): 0.1 (approx) (each)

Shipping Weight: 0.015 kg

Shipping Dimensions: 2 × 2 × 2 cm

8. <u>HC SR 04 Ultrasonic sensor</u>

Model No.: HC SR04

Operating Voltage (V): 5

Avg. Current Used (mA): 2

Frequency (Hz): 40000

Sensing Angle: 15°

Max. Sensing Distance (cm): 450

Weight (g): 9

Sensor Cover Dia. (mm): 16

PCB Size (L x W) mm: 45 × 20

Shipping Weight: 0.014 kg

Shipping Dimensions: 5 × 4 × 3 cm

CHAPTER 5
TESTING AND RESULTS

5.1 Testing and results

To ensure the functionality and reliability of the railway accident mitigation system, various test cases were designed and executed under controlled conditions. Each module was tested individually and then as part of the integrated system. The testing focused on the following components:

5.1.1 IR Sensor Accuracy:

- Test to detect train arrival and pedestrian presence at a specific distance.
- Sensors placed at various angles to verify consistent detection.

5.1.2 Smart Gate Mechanism:

- Tested the automatic opening/closing action of the servo motor based on train detection.
- Buzzer and LED tested to alert pedestrians before gate closure.

5.1.3 Collapsible Bridge System:

- Tested whether the bridge retracts when a train is detected.
- Ensured bridge extends again once the train has passed.

5.1.4 Arduino Coordination:

- Verified if Arduinos work in sync for safe and timely control of gate and bridge.
- Delay and sensor response time were optimized.

5.1.5 System Integration:

Complete flow tested:

pedestrian crossing → train detection → gate closing + bridge lifting → train pass → reset.

5.1.6 Final debugging:

The Arduino IDE serial monitor was for final debugging and tunning for best timing and smooth operation of all sensors and electronics.

CHAPTER 6:

CONCLUSION

6.1 conclusion

The proposed Railway accident mitigation system, developed using just two Arduino boards and IR sensors, successfully demonstrates a low-cost, efficient solution to enhance safety and convenience at railway crossings. By automating gate operations and integrating a collapsible bridge between platforms, the system significantly reduces the risk of pedestrian accidents and improves the flow of people without relying on long or unsafe paths.

In real-life implementation, such a system can prevent countless accidents at unmanned crossings, reduce human intervention, and ensure smoother train operations. The collapsible bridge offers an innovative alternative to traditional overpasses, especially in crowded stations. Overall, this smart solution has the potential to modernize railway infrastructure, prioritize pedestrian safety, and make Indian railways smarter and safer.

CHAPTER 7:

FUTURE SCOPE

7.1 Future scope

The Railway accident mitigation system presents multiple avenues for future development and real-world implementation:

1.IoT Integration: The system can be connected to the cloud to enable real-time monitoring of gate status, train movements, and sensor health. This can be useful for remote supervision and data analytics.

2.AI-Based Obstacle Detection: Advanced vision systems or AI algorithms can be used for detecting obstacles like people, animals, or vehicles on the track with better accuracy than basic IR sensors.

3.Solar-Powered Operation: To promote energy efficiency and allow deployment in remote or rural areas, solar panels can be integrated for powering the system independently.

4.Mobile Notifications: Alerts about incoming trains and gate closures can be sent to pedestrians or commuters via mobile apps or SMS, improving awareness and safety.

5.Accessibility Features: Voice announcements and tactile feedback systems can be added for visually impaired users at crossings and platforms.

6.Scalability for Large Stations: The system can be expanded to manage multiple gates and collapsible bridges across various platforms using a central controller.

7.Integration with Railway Signaling: By syncing with official train signaling systems, the gate and bridge operations can become even more reliable and accurate.

These advancements can transform the prototype into a full-fledged safety and convenience solution suitable for deployment in urban and rural railway infrastructure.

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