The Safety Train Guardian System

Introduction: In the dynamic landscape of modern transportation, ensuring the safety of railway operations is paramount. The Safety Train Guardian System (STGS) is an innovative project designed to elevate the standards of safety and security within the realm of train transportation. This system aims to mitigate risks, prevent accidents, and ensure the well-being of both passengers and railway personnel. The project incorporates a combination of advanced technologies and proactive monitoring strategies to create a robust safety framework. The primary objective of this project is to develop a state-of-the-art safety system that contributes to the overall safety of train operations, protects passengers and crew, and improves the efficiency of response to critical situations. By leveraging advanced technology and interfacing with the train's control system, the Safety Train Guardian System aims to mitigate risks and enhance the overall safety standards in the railway industry. The "Safety Train Guardian System" is a comprehensive safety project designed to enhance the safety measures associated with train operations. This innovative system integrates various peripherals and interfaces to address critical aspects of train safety, including collision avoidance, track condition monitoring, passenger safety, emergency communication, and automated emergency brake override.

1. Collision Avoidance System: Utilize a combination of sensors and cameras to detect obstacles or potential collisions on the train tracks. Interface the collision detection system with the train's control system to trigger automatic braking or provide alerts to the train operator.

2. Track Condition Monitoring: Implement sensors to continuously monitor the condition of the train tracks in real-time. Interface with a computer system to analyze data and provide maintenance alerts for sections of track that may require attention.

3. Passenger Safety and Surveillance: Integrate surveillance cameras within train cars to monitor passenger safety and detect unusual activities. Interface the surveillance system with a central monitoring station for real-time surveillance and incident response.

4. Emergency Communication System: Develop an emergency communication system that allows passengers and train staff to send alerts in case of emergencies. Interface the communication system with the train's control center and emergency services for swift response.

5. Automated Emergency Brake Override: Implement a system capable of overriding the train's brakes in emergency situations, ensuring a rapid response to potential hazards.

6. User Interface for Train Operators: Design a user-friendly interface for train operators that provides real-time data on safety parameters, track conditions, and emergency alerts.

Equipment:

1. Arduino,
2. Ultrasonic sensor,
3. Servo motor,
4. Blinking light,
5. Alarm ,
6. Remote sensor,
7. PVC board ,
8. Train,
9. Wire (male to male, male to female , female to female),
10. Glue Silicon,
11. Solder wire,
12. Breadboard small,
13. Register,
14. LED,
15. M/F wire,
16. Gum.

Procedure:

Step 01:

Rail line set up: Establishing a rail line is a complex and multifaceted undertaking that involves meticulous planning, precise engineering, regulatory compliance, and strategic execution. A rail line serves various purposes, from alleviating traffic congestion to reducing environmental impact and promoting economic growth.

Setting up a rail line involves several key steps, from planning and design to construction and operation. Here's a general guide on how to set up a rail line:

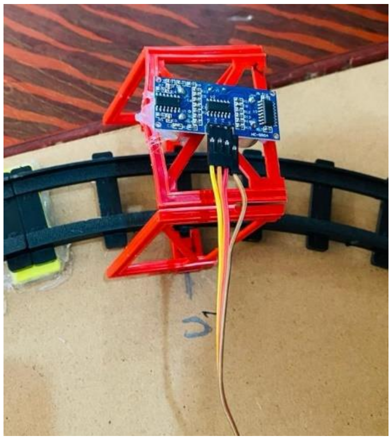
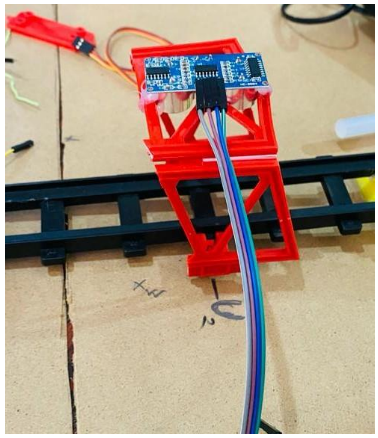
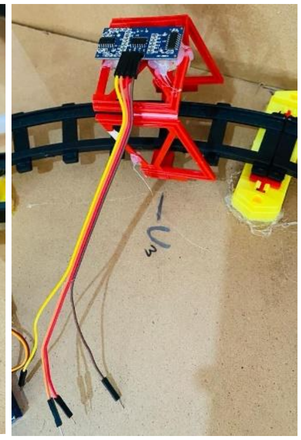
1. Mark the measurements and set up the PVC board.
2. Rail way tracks have to be set up.
3. Rail line tracks have be set up.
4. A station room should be made.

Step 02:

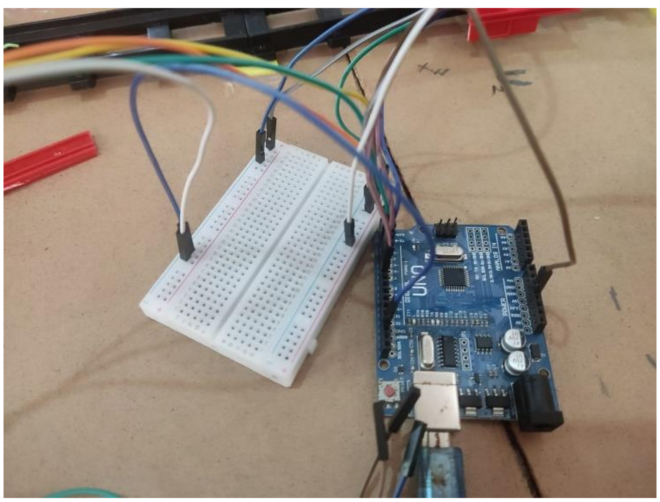
Sensor set up: Setting up sensors is a crucial step in creating a system that can gather data from the physical world. Sensors are devices that can detect and measure physical properties such as temperature, pressure, light, motion, and many others.

Setting up sensors involves a series of steps to ensure proper integration and functionality. Here's a general guide to sensor setup:

1. Ultrasonic sensor needs to be set up (sensor 1, sensor 2, sensor 3).

2. The sensors are connected to the Arduino.

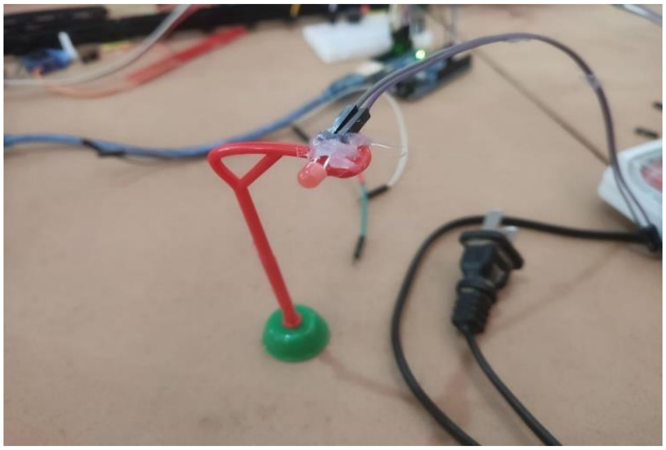


Step 03:

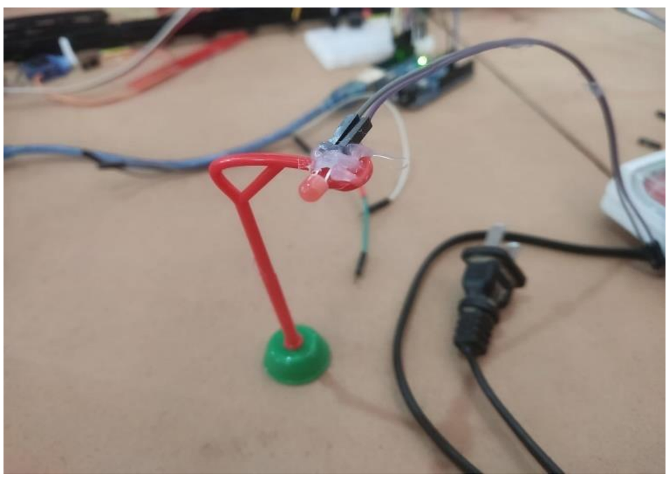
LED & Alarm set up: A Light Emitting Diode, or LED, is a semiconductor device that emits light when an electric current passes through it. An alarm circuit is a system designed to generate an alert or warning signal in response to a specific trigger or condition. Alarms can be used for various purposes, such as security systems, notifications, or signaling events.

Setting up LED and alarm systems can vary depending on the specific components we have and the desired functionality. Below is a general guide to led & sensor set up:

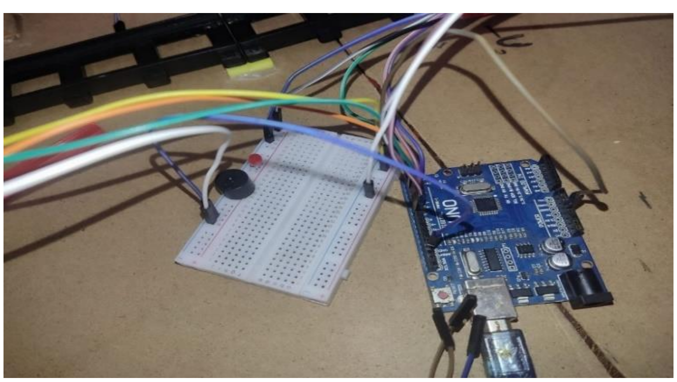
1. After sensor 1, red light should be set up.



2. After sensor 2, red light should be set up.



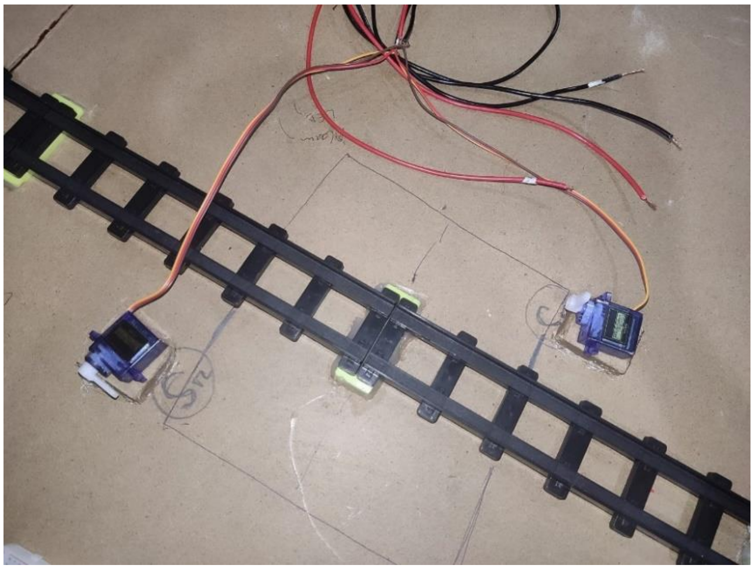
3. After that, the led and alarm connection should be set up.



Step 04:

Servo set up: A servo motor is a versatile and commonly used component in electronics and robotics. It is designed for precise control of angular position, making it ideal for applications where accurate and controlled movement is essential. Setting up a servo involves connecting it to a power source and a control signal, typically facilitated by a microcontroller.

1. Servo motor 1 & 2 should be set up.



2. Train signal and it has to be detected ON.

Step 05:

Remote sensor used: Remote sensors play a crucial role in modern trains, contributing to various aspects of train operation, safety, and maintenance. They enable the collection of real-time data, allowing for better decision-making and overall improvement in the performance of train systems.

Source Code:

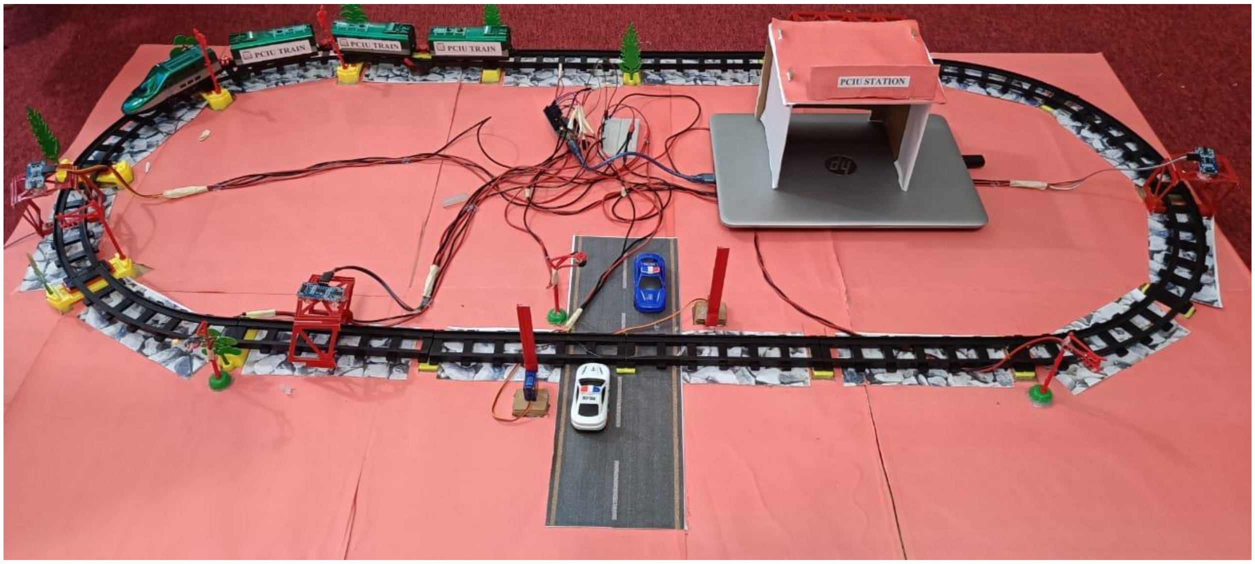
```
#include <Servo.h>
Servo myservo;
int pos = 0;
int flag = 0;
const int trigPin1 = 2;
const int echoPin1 = 3;
const int trigPin2 = 4;
const int echoPin2 = 5;
const int trigPin3 = 6;
const int echoPin3 = 7;

// defines variables
long duration1, duration2, duration3;
int distance1, distance2, distance3;

void setup() {
  pinMode(trigPin1, OUTPUT);
  pinMode(echoPin1, INPUT);
  pinMode(trigPin2, OUTPUT);
  pinMode(echoPin2, INPUT);
  pinMode(trigPin3, OUTPUT);
  pinMode(echoPin3, INPUT);
  Serial.begin(9600);
  pinMode(8, OUTPUT);
  myservo.attach(9);
  pinMode(10, OUTPUT);
  pinMode(11, OUTPUT);
  }
```

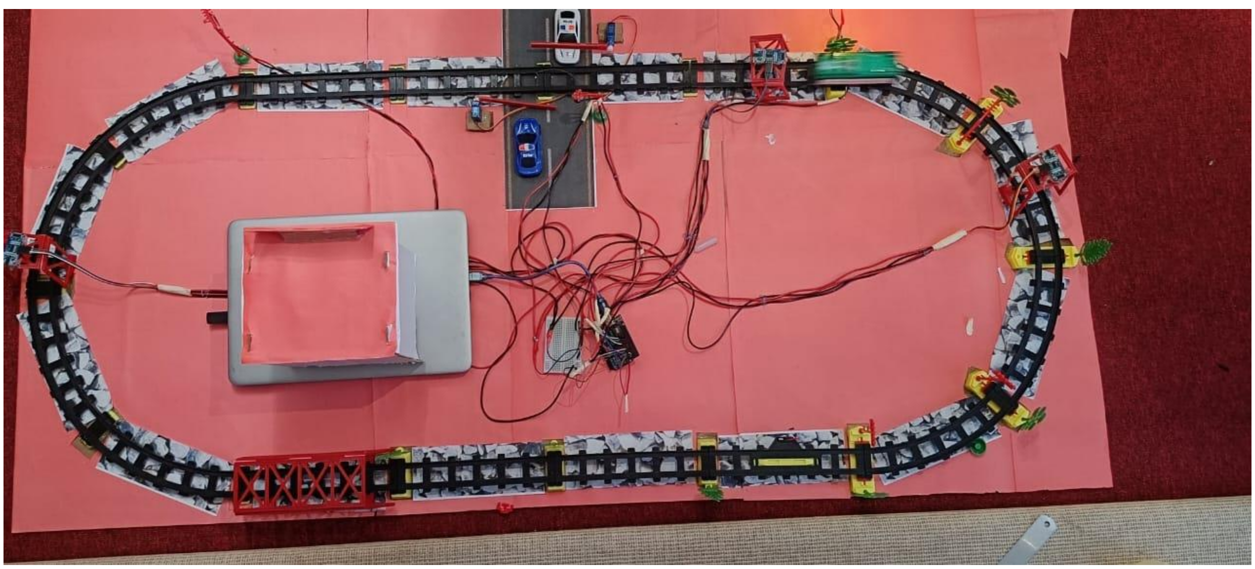
```
void loop() {
// Sensor 1
digitalWrite(trigPin1, LOW);
delayMicroseconds(2);
digitalWrite(trigPin1, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin1, LOW);
duration1 = pulseIn(echoPin1 , HIGH);
distance1 = duration1 * 0.034 / 2;
if(distance1<4 && flag==0 && distance1>0){
  digitalWrite(8, HIGH);
  digitalWrite(10, HIGH);
  digitalWrite(11, LOW);
  flag=1;
}else if(distance1<4 && flag>0){
  digitalWrite(11, LOW);
}
// Sensor 2
digitalWrite(trigPin2, LOW);
delayMicroseconds(2);
digitalWrite(trigPin2, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin2, LOW);
duration2 = pulseIn(echoPin2, HIGH);
distance2 = duration2 * 0.034 / 2;
if(distance2<4 && flag>0){
  flag=2;
digitalWrite(8, LOW);
```

```
for (pos = 0; pos <= 100; pos += 1) {
// in steps of 1 degree
myservo.write(pos);
}
delay(6000);
for (pos = 100; pos >= 0; pos -= 1) {
  myservo.write(pos);
  delay(10);
}
}
//Sensor 3
digitalWrite(trigPin3, LOW);
delayMicroseconds(2);
digitalWrite(trigPin3, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin3, LOW);
duration3 = pulseIn(echoPin3, HIGH);
distance3 = duration3 * 0.034 / 2;
if(distance3<4 && flag==0 && distance3>0){
  digitalWrite(10, LOW);
  digitalWrite(11, HIGH);
  digitalWrite(8, HIGH);
  delay(4000);
  digitalWrite(8, LOW);
flag=10;
for (pos = 0; pos <= 100; pos += 1) {
  // in steps of 1 degree
myservo.write(pos);
}
```

```
  delay(6000);
  for (pos = 100; pos >= 0; pos -= 1) {
  myservo.write(pos);
   delay(10);
  }
  }else if(distance3<4 && flag>0){
    digitalWrite(10, LOW);
  }
  if(flag<30 && flag>0){
    flag++;
  }
else{
    flag=0;
  }
  Serial.print("Distance1: ");
  Serial.println(distance1);
  Serial.print("Distance2: ");
  Serial.println(distance2);
  Serial.print("Distance3: ");
  Serial.println(distance3);
  Serial.print("wating: ");
  Serial.println(flag);
  delay(400);
}
```

Output:





Discussion: The project represents a leap forward in technological innovation for the railway industry. The Automated Emergency Brake Override system showcases the integration of smart technologies to enable rapid responses to emergency situations. Integrating multiple safety features requires a sophisticated and well-coordinated approach. Ensuring seamless communication and interaction among different subsystems is crucial for the system's success. Meeting regulatory standards and obtaining necessary approvals pose challenges. Adherence to safety and environmental regulations is paramount for the acceptance and deployment of the Safety Train Guardian System. Designing a user-friendly interface for train operators is critical. The interface should provide real-time data without overwhelming the operator and should facilitate quick decision-making in emergency situations. The implementation of the Safety Train Guardian System is expected to lead to a significant reduction in accidents and incidents, thereby improving overall safety statistics in the railway industry. The proactive maintenance approach enabled by track condition monitoring contributes to increased operational efficiency. Reduced downtimes result in more reliable and timely train services. Passengers benefit from increased safety measures, real-time communication, and improved travel conditions, leading to an overall positive travel experience. The project has the potential to set a new benchmark for safety standards in the railway industry. Successful implementation could inspire similar initiatives globally."The Safety Train Guardian System" is poised to revolutionize railway safety through its innovative approach to collision avoidance, track monitoring, passenger safety, and emergency response. The integration of advanced technology not only addresses current safety challenges but also positions the railway industry for a safer and more efficient future. This project represents a collaborative effort to prioritize safety, enhance technological capabilities, and create a sustainable and secure railway system for the benefit of passengers and industry stakeholders alike.