MINI PROJECT

APPLIED PHYSICS

1. ABSTRACT

Automated railway crossing systems enhance safety and efficiency by using sensors, microcontrollers, and wireless communication to detect trains and control gates automatically. The system ensures real-time alerts, fail-safe operations, and reduced reliance on manual intervention, minimizing risks and delays. This adaptable solution modernizes railway infrastructure for diverse environments

2. INTRODUCTION

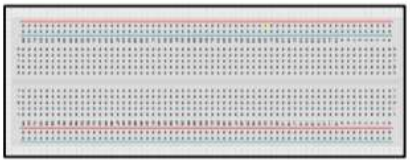
In recent times, there are a lot of mishaps happening at the railway intersection, a major one of them is due to the collision of roadway vehicles and railway train. Even though there are traditional manual systems for this, but due to their proneness to human error and delays, makes them least suitable choice. A solution to all of this is, "**AUTOMATED RAILWAY CROSSING**". Automated railway crossings are systems designed to enhance safety and efficiency at intersections where railways and roadways meet. In this mini project, we aim to design and implement an automated railway crossing system that utilizes sensors and microcontrollers to detect approaching trains and manage crossing gates accordingly. The system will feature real-time monitoring of train positions, automated activation of warning signals and barriers. By integrating these technologies, the project seeks to minimize accidents at railway crossings and improve the overall flow of road traffic.

3. APPARATUS AND COMPONENTS

1. Arduino UNO R3

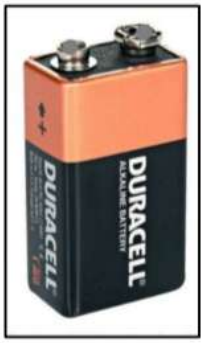
This is a **Arduino UNO R3 Microcontroller** . It has 20 pins on it out of which (6 pins are digital pins) and (6 pins are Analog Pins). The code in the Arduino can be uploaded through its software **Arduino IDE**.

2. Breadboard



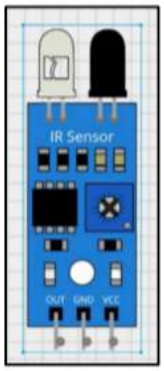
A breadboard (sometimes called protoboard) is essentially the foundation to construct and prototype electronics. A breadboard allows for easy and quick creation of temporary electronic circuits or to carry out experiments with circuit design

3. Battery (9 v)



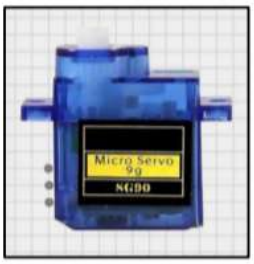
This is a 9V BATTERY which powers the Arduino board and is connected through 2.5mm jack present on the Arduino board

4. IR Sensor



An infrared (IR) sensor is an electronic device that detects infrared radiation, a part of the electromagnetic spectrum invisible to the human eye, and can be used for various applications like motion detection, temperature measurement, and object presence detection. **(high = No Object Detected) and (Low = Object Detected**)

5. Servo Motor



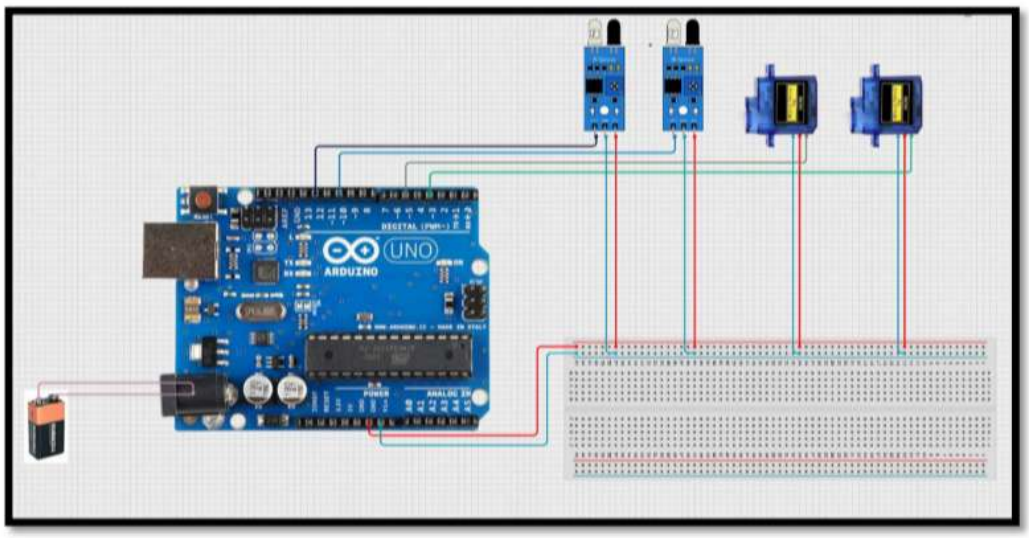
A servo motor is a rotary or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration in a mechanical system, often used in robotics and automation.

6. Train model

Toy train Used in the model

WORKING AND CONSTRUCTION

❖ CONSTRUCTION



The construction of the Automated Railroad Crossing contains minimal device

1. Arduino UNO R3
2. Breadboard
3. Battery
4. IR sensor
5. Servo Motor
6. Toy Train
7. Connections miscellaneous

The battery is connected to the Arduino using 2.5mm jack which transfers 9v in the Arduino giving it enough power to run all the connected devices without any lag.

The Arduino is further connected to the breadboard using Jumper Wires and the 5v is connected to the **positive** and GND is connected to the **negative** of the breadboard line.

Further all the devices are connected to Arduino and breadboard in following ways (All Devices)

- **VCC** = connected to power source on breadboard (Positive Line).
- **GND** = connected to ground source on breadboard (Negative Line).
- **OTP** = connected on Arduino digital pins as per the code declaration pin.

Generally ,

- VCC (power) wire is **RED** in colour.
- GND (ground) wire is **BLACK** in colour.
- OTP (output) wire is **YELLOW** in colour.

ALL THE CONNECTIONS ARE BEEN SPECIFIED IN THE IMAGE ABOVE

Moving Towards Working ,

The IR sensors are connected on pin (8 and 12) respectively.

The Servo motors are connected on pin (3 and 5) respectively.

As we know the IR sensor gives digital signals about detection of object.
Both the sensors are on HIGH i.e no object detected. when they detect object the signal changes to LOW.
The servo motors (initially at 0) are programmed in a such a way that when sensor 1 detects train the gates closes and servos turns by 90 from initial position 0. When the sensor 2 detects the train the gates open and servos turn form initial position 90 to 0 which is its declared position .
The code is uploaded through the ARDUINO IDE and the image of the code is as follows..

ARDUINO UNO R3 CODE

```ino
#include <Servo.h>

Servo Servo1; //3RD PIN
Servo Servo2;  //5TH PIN

const int irSensor1 = 8;
const int irSensor2 = 12;

int position = 0;
int sensor1State = 0;
int sensor2State = 0;

void setup() {
  Servo1.attach(3);
  Servo2.attach(5);
  pinMode(irSensor1, INPUT);
  pinMode(irSensor2, INPUT);
  Servo1.write(position);
  Servo2.write(position);
}

void loop() {
  sensor1State = digitalRead(irSensor1);
  sensor2State = digitalRead(irSensor2);


  if (sensor1State == LOW && position == 0) {
    position = 100;
    Servo1.write(position);
    Servo2.write(position);
    delay(10);
  }
  if (sensor2State == LOW && position == 100) {
    position = 0;
    Servo1.write(position);
    Servo2.write(position);
    delay(10);
  }
}
```

FUTURE ASPECTS AND DISCUSSION

The future of automated railroad crossing systems looks promising, with advancements in AI, IoT, and smart infrastructure enhancing safety, efficiency, and reliability. Here are some key aspects:

1. AI-Powered Predictive Maintenance

AI and machine learning will predict failures in barriers, sensors, and signaling systems before they happen.

Drones and robots might inspect tracks and crossings, reducing manual checks.

2. IoT & Real-Time Monitoring

Smart sensors and IoT devices will provide real-time data on train movements, weather, and crossing conditions.

Authorities and drivers can receive instant alerts via mobile apps or vehicle infotainment systems.

3. Smart Barriers & Warning Systems

Adaptive barriers with AI-based decision-making could open or close based on train speed, visibility, and traffic conditions.

Laser-based or holographic warning signs might replace traditional gates.

4. Integration with Smart Cities

Automated railroad crossings will sync with traffic management systems to optimize vehicle flow and reduce congestion.

With these advancements, automated railroad crossings will become safer, smarter, and more efficient, significantly reducing accidents and improving transportation flow.

REFERENCES

- Device images = google.com
- Circuit diagram = online circuit builder (cirkit.com)
- Connections = youtube.com
- Devices required = youtube.com , Amazon.com
- Information = Wikipedia and google.com
- Arduino IDE and Code = Youtube tutorials

Websites

1. https://www.google.co.in/
2. https://www.youtube.com/
3. https://www.wikipedia.org/
4. https://www.cirkitstudio.com/