Project Title: Smart Railway Anti-Collision System with Auto Track Change and Obstruction Sensing for Accident Prevention

Aim:

The main aim of this project is to build a smart railway safety system that prevents train collisions by detecting obstacles or other trains on the track and automatically switching the train to a safe track.

Objectives:

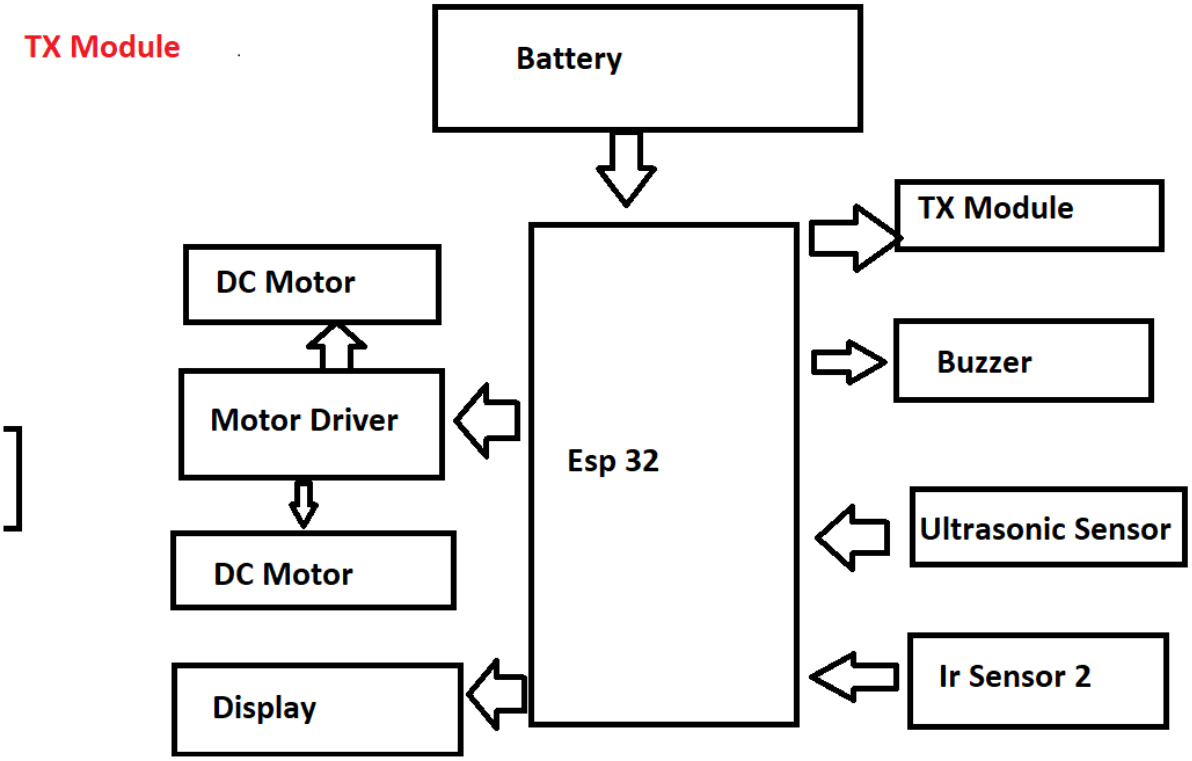
- To detect obstacles or another train on the same track.
- To stop or redirect the train automatically to avoid accidents.
- To ensure passenger safety using a real-time sensing system.
- To create a low-cost solution that can be implemented in real railways.

Working:

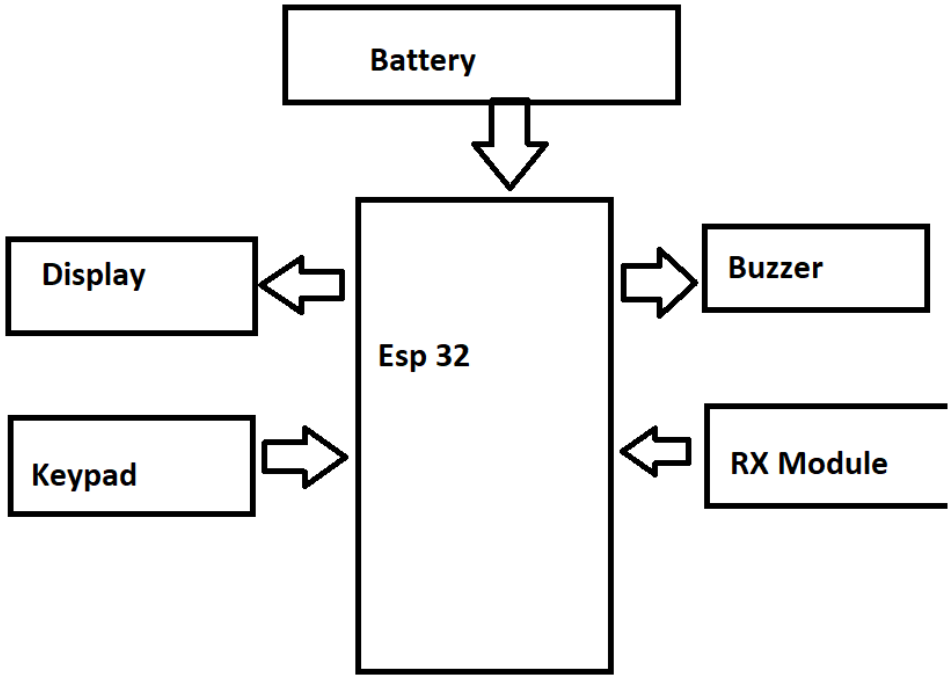
This system uses sensors placed on the train and track to detect any obstacle or another train ahead. If a threat is detected, the system sends a signal to stop the train or change its track using a motorized track switch. A microcontroller like Arduino or ESP32 is used to read the sensor data and control the motor or servo responsible for switching the tracks. For communication between two trains, RF modules can be used. The system works in real time and takes action before any collision happens.

Block Diagram

TX Module



RX Module



Components Used:

Hardware:

- **ESP32** – Main controller
- **Ultrasonic and IR Sensors** – For obstacle and train detection
- **RF Module (NRF24L01 / RF433)** – For wireless communication
- **Servo Motor** To control the track changer
- **Motor Driver (L298N)** – For train and servo motor control
- **Buzzer / LED** – For warning alerts
- **Battery Pack / Adapter** – To power the system
- **DC Motor**

Software:

- **Arduino IDE** – To write and upload the code
- **Embedded C / C++** – Programming language for logic

Advantages:

- Reduces chances of train collisions drastically.
- Fully automatic system, no manual control needed.
- Low-cost solution for railway safety.
- Works even on mini-models for educational use.

Disadvantages:

- Needs accurate sensor calibration.
- Limited RF communication range.
- Real-time full-scale implementation needs railway authority approval.

Applications:

- Can be used in metro, local trains, or long-distance railways.
- Suitable for railway crossings and station yards.
- Educational tool to demonstrate railway safety automation.
- Helpful in automatic train yards to manage traffic.

Future Scope:

- Add GPS and GSM for real-time location tracking and alerts.
- Add AI/ML models to improve prediction of danger zones.
- Solar-powered track-side units for remote areas.
- Integration with railway signal systems for better coordination.
- Cloud-based monitoring for multiple trains and routes.

Conclusion:

This project offers a smart and practical approach to prevent railway accidents. By detecting threats early and responding by changing tracks or stopping the train, it can save lives and reduce damage. It is a reliable and scalable system that, with further development, can be used in real-world railway networks