**TRAIN ACCIDENT PREVENTION SYSTEM**

Step 1: Train Movement Control

• Motor Control (M20 Gear Motor):

• The motor is used to control the movement of the toy train. The motor’s speed and direction can be controlled by the STM32 microcontroller via the Relay Module.

• The STM32 will output signals to the relay to power the motor for forward/backward movement and stop it when required.

• The motor will be powered by the LiPo battery.

• Relay Module:

• The Relay Module will act as a switch for the M20 motor, allowing the STM32 to control when the motor is powered or not.

• When an obstacle is detected, the STM32 will cut the motor’s power via the relay to stop the train.

Step 2: Obstacle Detection

• Doppler Pulse Radar:

• The radar sensor will continuously scan for moving objects ahead of the train. It detects changes in frequency due to moving obstacles using the Doppler effect.

• The radar’s output will be connected to the STM32 microcontroller for analysis.

• The radar sensor will trigger an interrupt or provide a signal to the STM32 when a moving object is detected ahead of the train.

• IR Sensors:

• Place motion detection sensors on both sides of the train to detect obstacles that may be directly in front or on the track.

• If an motion detector sensor detects an object (e.g., a barrier on the track), it will send a signal to the STM32 to stop the train.

Sensor Integration:

• The STM32 microcontroller will be programmed to receive data from the Doppler radar and IR sensors.

• Based on the proximity of obstacles or moving objects, the STM32 will process the input and decide the appropriate action.

• Decision-Making Logic:

• When a moving object is detected by the Doppler radar or a stationary object is detected by the IR sensors, the STM32 will activate the relay to cut power to the motor, stopping the train.

• If no obstacles are detected, the train will continue moving at its current speed.

Test Radar Sensitivity:

• Adjust the Doppler radar sensor to detect objects at a proper distance from the train.

• Ensure the radar’s detection range matches the expected range for safe stopping distance.

• IR Sensor Calibration:

• Test the IR sensors to ensure they accurately detect objects on the track and trigger a response in the STM32.

• Relay Control:

• Test that the relay can successfully stop or start the motor based on signals from the STM32.

• Battery Power:

• Ensure that the LiPo battery provides sufficient power for continuous operation without frequent recharge interruptions.

The toy train moves along the track powered by the M20 gear motor.

2. The Doppler radar scans for moving obstacles in the path of the train.

3. If an obstacle is detected, the radar sends a signal to the STM32.

4. The STM32 processes the data and sends a command to the relay module to stop the motor.

5. The train halts safely, preventing a collision or accident.

6. The IR sensor continuously monitors for obstacles directly in front of the train, ensuring additional safety.

7. The system can be reset or turned off using the switch.