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Design and Implementation of Train Accident Prevention Using IoT

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ABSTRACT

Railway Transport is indispensable in modern day life, both for business and private users. Nowadays, rail networks across the world are getting busier with trains travelling at higher speeds and carrying more passengers and heavier axle loads than ever before. The combination of these factors has put considerable pressure on the existing infrastructure, leading to increased demands in inspection and maintenance of rail assets. This work focuses on improving railway safety by alerting humans and animals on train tracks and preventing train collisions. These measures aim to reduce accidents, ensuring a safer railway environment and saving lives.This work has successfully integrated safety and efficiency measures, resulting in a more secure, efficient and comfortable rail industry experience. The use of ultrasonic and IR sensors has improved safety along train tracks, preventing accidents and increasing awareness with alert alarms.

Keywords: Cotton seed oil, Bio-fuel, Engine Performance, Emission

1. INTRODUCTION

Alerting humans and animals on tracks.

Railway tracks are crucial for transportation but pose safety hazards due to human and animal presence. Effective alert systems are essential to prevent accidents and ensure smooth operations.

Ultrasonic sensors are installed along the tracks to detect the presence of train, triggering loud auditory alarms and flashing lights to warn them of approaching trains. As shown in Figure 1.

Fig.1. Accident areas of populated area

Preventing collisions between trains.

Nowadays, lot of accidents occur due to improper communication among the network like wrong signaling, worst weather condition, immediate route change, etc.,

The train driver doesn't get proper information on time and before time so that the hazardous condition can occur. We propose this system to avoid train collision by using IR Sensors to provide communication between trains and to avoid same track collisions as shown in fig 2

This integrated approach aims to public education campaigns about railway safety and strict enforcement of regulations further enhance the protection of both people and animals, ensuring safer railways for all and reducing the risk of train collision.

Fig.2 Train derailing due collision

2.METHODOLOGY

2.1 Block Diagram

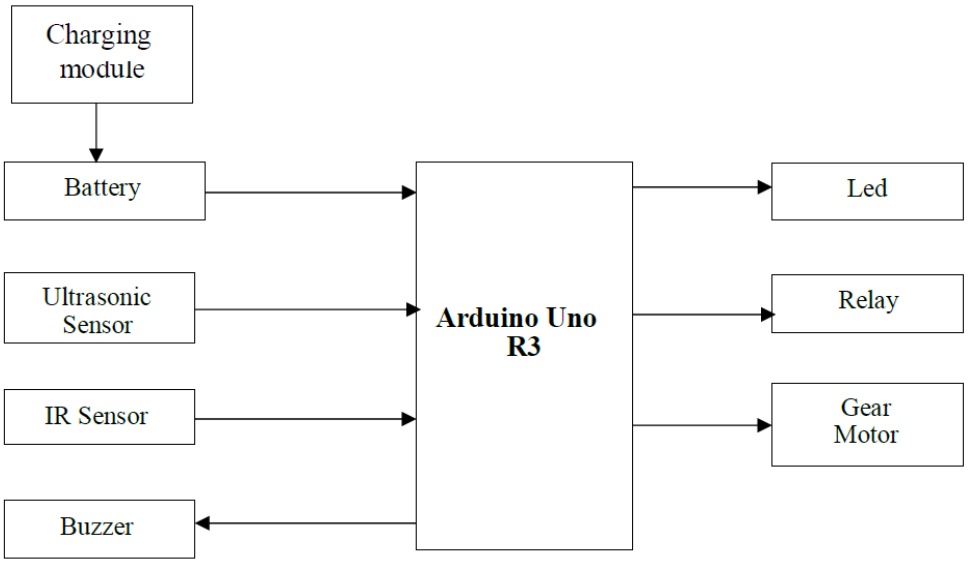


Fig.3 Block Diagram of proposed accident prevention system

The block diagram shown in fig.3 for the railway track system consists of an Adriano Uno R3 microcontroller, an ultrasonic sensor for obstacle detection, an IR sensor for train presence detection, a buzzer and LED for

alerting, a 9V battery-powered N20 gear motor for train movement, a 5V relay for motor control, and a manual switch for manual control. When an obstacle is detected, the Arduino triggers the buzzer and LED, and the IR sensor triggers the relay to stop the train automatically.

2.2 Circuit Diagram

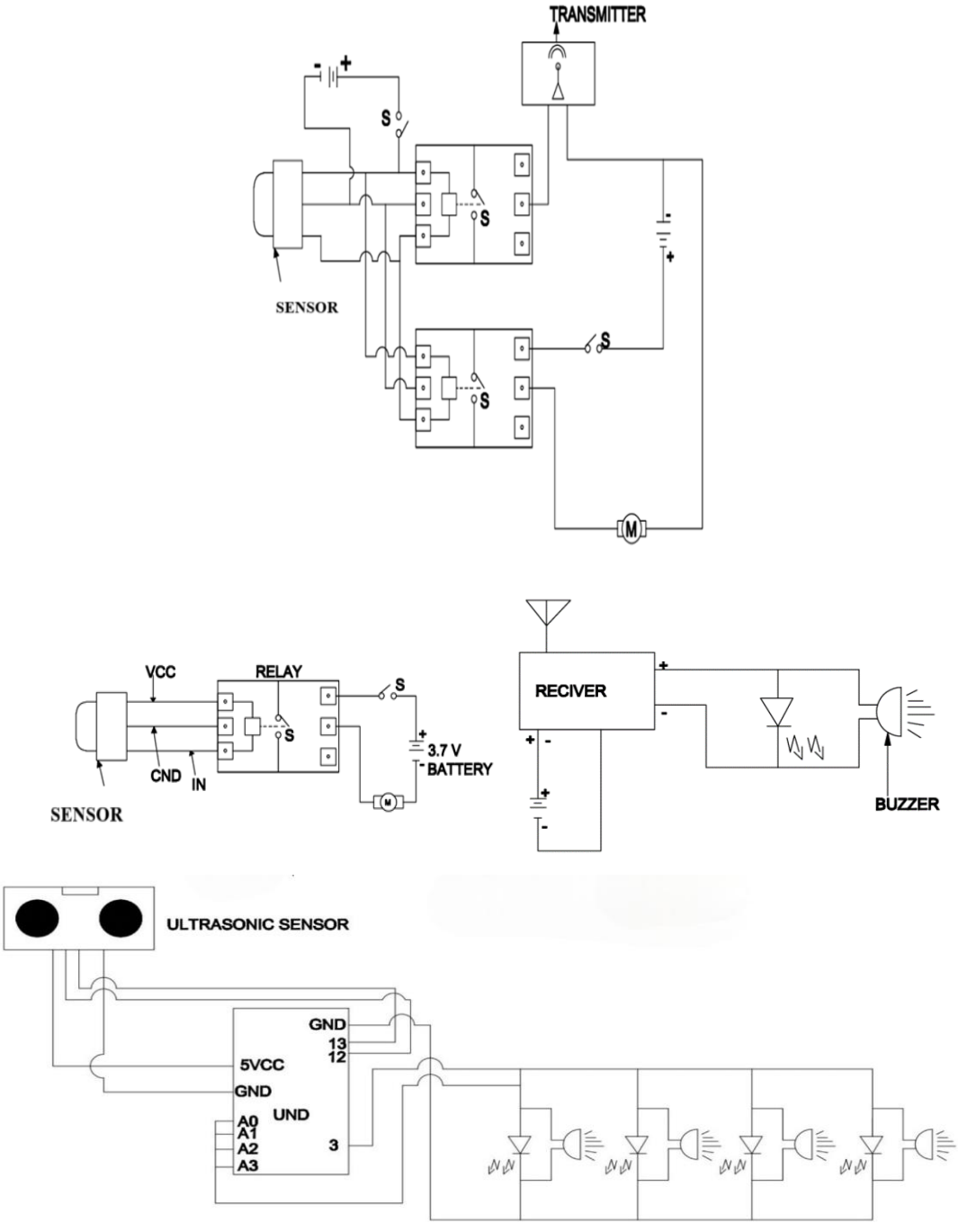


Fig. 4 Circuit diagram

3. HARDWARE REQUIREMENTS

Arduino UNO

Arduino UNO is a microcontroller board based on the ATmega 328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), ,6 analog inputs, a 16MHz ceramic resonator , a USB connection , a power jack ,an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with simply connect it to a computer with a USB cable or power it with UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again .

Fig.5 Arduino UNO

Ultrasonic sensor

As the name indicates, ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the emission and reception.

SPECIFICATIONS

- Measures distance: Calculates distance to an object using high-frequency sound waves
- Operating principle: Sends and receives ultrasonic pulses, measuring time to determine distance
- Typical range: 2-400 cm
- Common applications: Obstacle detection, proximity sensing, robotics, and automation projects

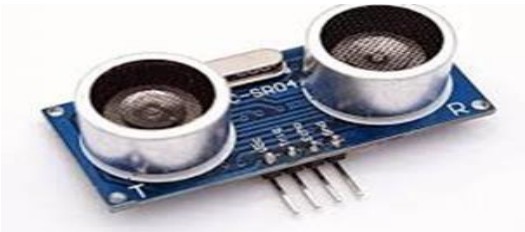


Fig.6. Ultrasonic Sensor

IR SENSOR

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiations rather, radiate some form of thermal radiation.

SPECIFICATIONS:

Detecting Range – Between 10cm and 80cm

Current consumption – Low current draw less than20mA

VCC--3.3 to 5V DC supply

Output Type- Analog or digital output

Wavelength-Around 850nm to 950nm

Fig 7 IR Sensor

N20 Gear motor

The N20 gear motor is a compact, high-performance motor and gearbox combo ideal for robotics projects. It offers high torque for heavy lifting and continuous rotation, slow speed for precise control, and a durable metal gearbox. Its compact size makes it perfect for small projects, and its reliability and ease of integration make it a popular choice among robotics enthusiasts and DIY electronics hobbyists.

SPECIFICATIONS

Model:GA12-N20

Rated Voltage:6-12V

Revolving Speed:100RPM@6V

LoadSpeed:80RPM

Fig 8 N20 Gear Motor

Relay

A Relay is a simple electromechanical switch. While we use normal switches to close or open a circuit manually, aRelayis also a switch that connects or disconnects two circuits. But instead of a manual operation, a relay uses an electrical signal to control an electromagnet, which in turn connects or disconnects another circuit.

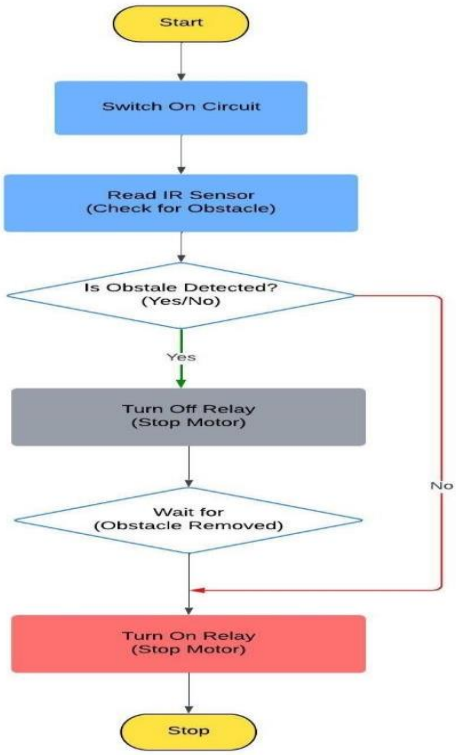
Fig 9 Relay

4. SOFTWARE REQUIREMENTS

Arduino IDE (2. 0. 9):

- **IDE:** Utilize the Arduino IDE for code development.
- **Language:** Write code in C/C++.
- **Libraries:** Incorporate sensor libraries for interfacing.
- **Sensor Integration:** Code for sensor initialization, data reading, and processing.
- **Alert System:** Develop functions to trigger alarms based on sensor data..
- **Safety Features:** Include error handling and fail-safes.
- **Testing:** Use IDE tools for testing and debugging.

Flow Chart



5. IMPLEMENTATION

Alerting humans and animals on tracks.

The railway track system is controlled by an Arduino Uno R3, which receives input from various sensors and

controls outputs to different components. The system includes an ultrasonic sensor to detect obstacles in the train's path, and an IR sensor (E18-D80NK) to detect the train's presence on the track. When an obstacle is detected, the ultrasonic sensor signals the Arduino which then triggers the buzzers to sound an alert and the LED to light up.

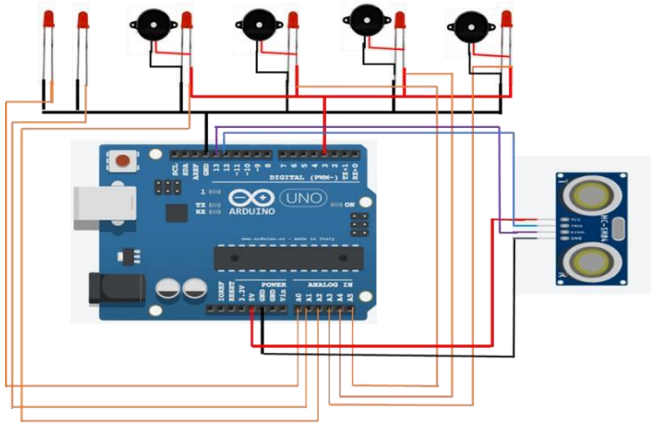


Fig 9 Connection diagram

Preventing collisions between trains

The system has a train that runs on a railway track. The train is powered by a 9v battery. The movement of the train is controlled by a small motor (N20 gear motor) which is connected to a relay (5v). The relay is like a switch that turns the motor on/off. The relay is triggered switch that turns the motor on/off. The relay is triggered by an IR sensor (E18-D80NK), with a detection range of 2-80cm, that detects when the train is near. This allows the train stop automatically. There's also a manual switch that lets you control the train manually.

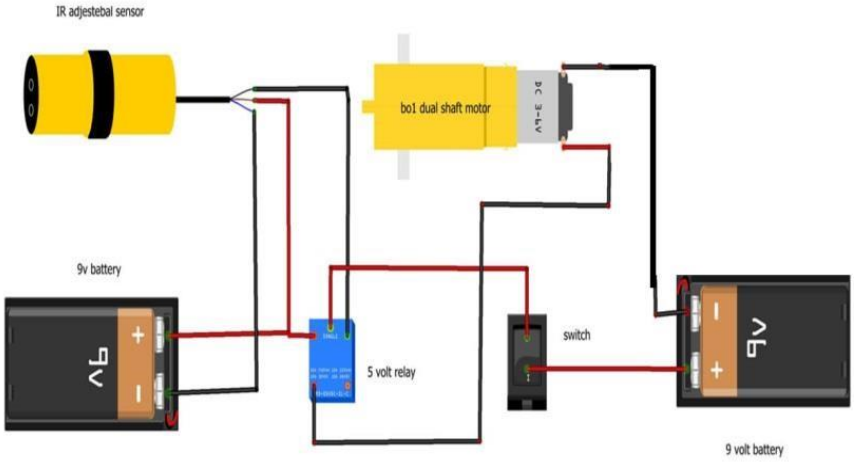
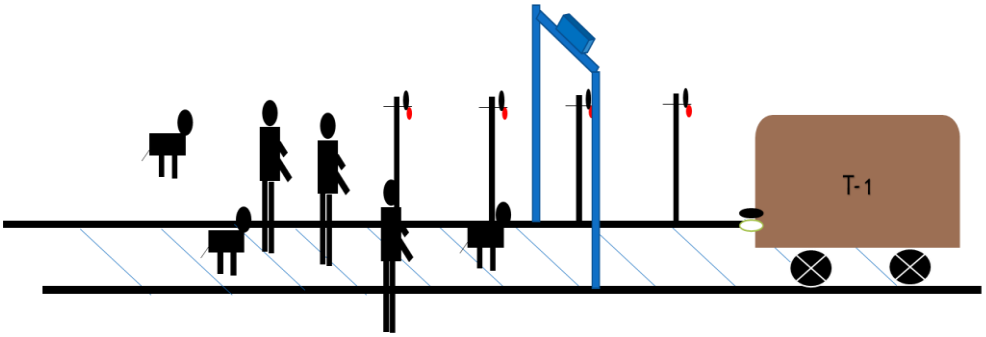


Fig.10Connection diagram

5. WORKING:

- **Alert alarm for humans & animals while walking on the train track**



- **Automatic train stop when two trains are in same train track**

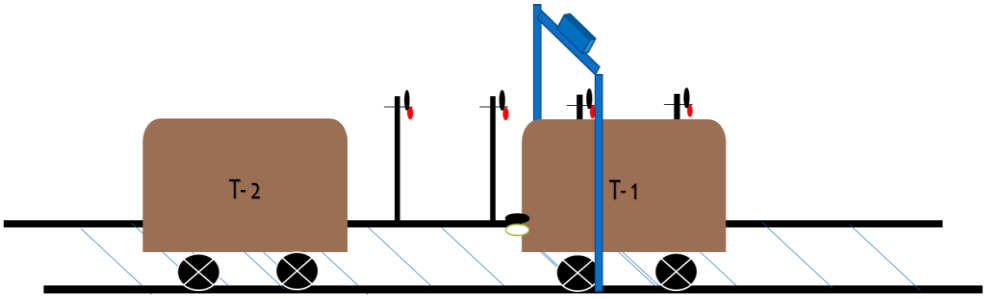


Fig. 11

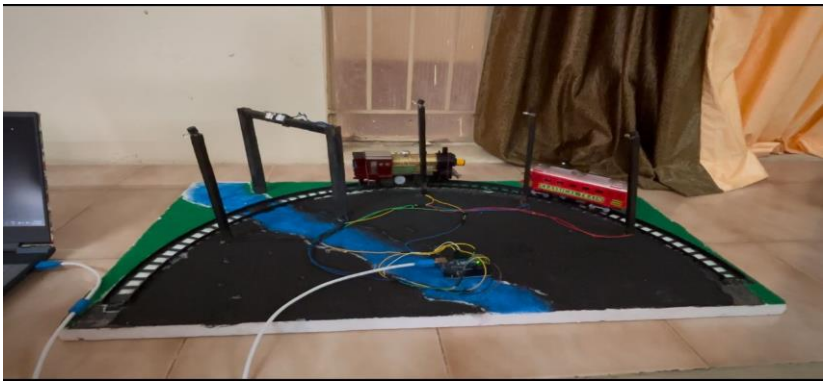
- **Ultrasonic Sensor for Train Sound Detection:** these sensors installed along tracks and those are emitted ultrasonic waves that bounce off objects when a train approaches it generates sound and reflect back to the sensor and indicates presence of train.
- **Alert Alarm Activation:** when train is detected then ultrasonic sensor triggers alert alarm, the alarm alerts nearby humans and animals to clear the track**.**
- **Infrared (IR) Sensors for Train Detection:** It installed at strategic point of train1 to monitor train2 presence.
- **Automatic Train Stop Mechanism:** Upon detecting presence of train2 using IR sensor, the system calculates the distance between trains on the same track. If two trains are to close to each other, indicating a potential collision risk, the system activates an automatic braking mechanism. The brakes are applied to trains and stopped at a safe distance.

Safety measures: Signage and warnings are placed along the tracks to educate the public about the presence of these safety systems. Continuous monitoring and maintenance of sensors ensure their reliability and effectiveness. Regular training for train operators and track maintenance personnel on the proper use and maintenance of these safety systems is conduct

6. RESULT

- **Alerting humans and animals on track.**

- **Preventing collisions between trains**



7. CONCLUSION

This work has successfully integrated safety and efficiency measures, resulting in a more secureand efficient and comfortable rail industry experience. The use of ultrasonic and IR sensors has improved safety along train tracks, preventing accidents and increasing awareness with alert alarms. Additionally, the project has enhanced operational efficiency and significantly reduced the risk of train collisions, ensuring a safer journey for passengers and staff. The implementation of advanced technologies, collaboration between stakeholders, and a focus on reducing operational costs and risks have set a new standard for the industry, with the potential to impact transportation safety and efficiency in other industries. Overall, this work is a significant step forward in enhancing the overall rail industry experience.

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SITUATION	YES	NO
Presence of human ,animals or any other obstacle etc. on track.	Train stops at a distance of 36 cm from the instant of detection.	Train do not stop it continues to move
Presence of train coming in opposite direction on same track.	Both train stops at a particular distance and alert signal goes to station authority	Train continues to move
While train is running on the track at un-maned location.	All LED glows and buzzers turns on	**N/A**

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