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Prevention of Railway Accidents Using Arduino-Based Safety System

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Abstract – This article outlines a design strategy for an Arduino-based safety system to prevent railway accidents. When a train is 500 meters away from an object (a person or an animal), this railway accident prevention safety system commands the person or animal if it is on the track. In this system, a high-frequency sound wave is transmitted by an ultrasonic sensor, which then waits for the sound to return before calculating the distance based on the required amount of time. In order to alert people to the impending arrival of a train, an ultrasonic sensor works by scanning for and identifying the vehicle. It then sends a signal to a buzzer to generate an alarm on the railway track.

Keywords – Arduino, Ultrasonic Sensor, Buzzer, DC Servomotor, LED Lights.

I. INTRODUCTION

Avoiding Railroad Accidents A project using an Arduino-based safety system aims to avoid accidents on train tracks. We are aware that the country's most popular mode of transit is rail. Accidents are happening more frequently at the railway crossing. To prevent accidents on the rails, at crossings, etc., the government has adopted numerous measures. People are trespassing on the train rails these days. So, the project here is the detection of trains approaching the track. Arduino, an ultrasonic sensor, and a buzzer are used in this. The train that is approaching the track is detected by this ultrasonic sensor-based technology. The ultrasonic sensor is turned on by the Arduino. The proposed technology locates the train using ultrasonic sensors. A sensor placed between 500 meters or at our discretion can detect the arrival of the train.

II. SOME COMMONLY USED COMPONENTS

A. POWER SUPPLY

A system that supplies electrical or other types of energy to a load or group of loads linked to it is known as a power supply unit, or PSU. Converting electrical current from a source to the proper voltage, current, and frequency to power the load is the primary function of the power supply. We need a 5 volts DC power supply for our project in order to run all of the electronic parts that make up this system.

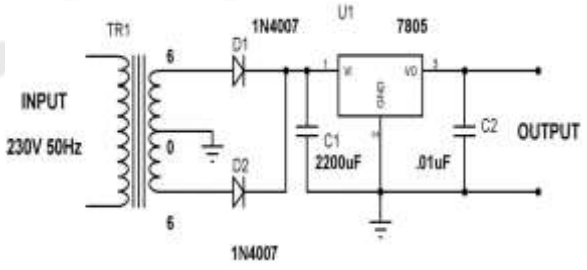

Fig 1: Power Supply Circuit

B. ARDUINO UNO

Based on the Microchip ATmega328P controller, Arduino Uno is an open-source microcontroller board. It features 14 pins for digital input and output. A USB cable that can handle voltages of 7 to 20 volts can be used to power it. Utilization is simple. It has a USB connector, 14 digital pins, and 6 analog pin inputs. It is IDE-based-programmed. It is compatible with offline and online platforms.

Fig 2: Arduino Uno

C. ULTRASONIC SENSOR

An ultrasonic sensor is a piece of technology that uses ultrasonic sound waves to measure a target object's distance and then turns the sound that is reflected back into an electrical signal. Ultrasonic waves move more quickly than audible sound—the kind of sound that people can hear—does. The transmitter, which uses piezoelectric crystals to produce the sound, and the receiver, which encounters the sound after it has gone to and from the target, are the two primary parts of an ultrasonic sensor. The sensor measures the amount of time that passes between the transmitter's sound emission and its contact with the receiver in order to determine the distance between the object and the sensor.

Fig 3: Ultrasonic Sensor

D. BUZZER

A beeper or buzzer, for example, could be electromechanical, piezoelectric, or mechanical in design. The signal is converted from audio to sound as its primary function. It is often powered by DC voltage and used in timers, alarm clocks, printers, computers, and other electronic devices. It can produce a variety of sounds, including alarm, music, bell, and siren, according on the varied designs.

Fig 4: Buzzer

E. DC SERVOMOTOR

One kind of electric motor used to precisely spin machine parts is a DC Servomotor, also known as a servo. This motor has a control circuit that gives feedback on the position of the motor shaft at any given time, making it possible for these motors to rotate precisely. It is advantageous to rotate an object at a certain distance or angle using a DC servomotor.

Fig 5: DC Servomotor

III. HARDWARE IMPLEMENTATION

The Arduino, which may be used as a microcontroller, is primarily responsible for controlling the system. It connects with an ultrasonic sensor to detect trains and generates an alarm on the track via a buzzer.

Below is a schematic block diagram of the system.

Fig A: Schematic block diagram

IV. METHODOLOGY

By employing an Arduino-based safety system to generate an alarm through a buzzer, any obstruction (people) can be alerted and made aware that a train is approaching them at a distance, preventing accidents on the railway track. Arduino serves as the microcontroller in this system. It features 14 pins for digital input and output. It is made up of a physical circuit board that may be programmed. A train's location is

found and tracked using an ultrasonic sensor. Alarms are generated at the track using buzzers. Train wheels are moved automatically by applying a switch using a DC servomotor. The circuit diagram of this project is shown below-

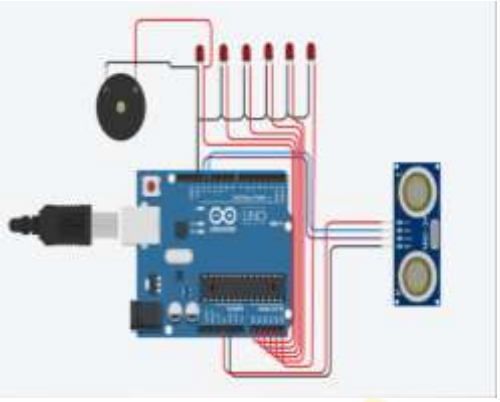

Fig: Circuit Diagram

In this circuit schematic, pins 12 and 13 of the Arduino are connected to the trigger and echo of the ultrasonic sensor, respectively. VCC of the ultrasonic sensor is linked to Arduino pin 5 while GND is connected to the ultrasonic sensor's GND.
Buzzer and LED Light are connected to Arduino's analog pins (A0 to A5).
By looking at the circuit diagram, we can see that the Arduino is being used as a microcontroller to send signals to an ultrasonic sensor through an echo and trigger. The ultrasonic sensor then detects a train and sends another signal to the analog pins of the Arduino, where a buzzer is connected to LEDs that it senses, causing the buzzer to produce an alarm and the light to blink.
LED bulbs can be used to create both a blinking light and an alert system that plays noises.
We don't use a DC servomotor to rotate railway wheels for real-time applications. We can put it into practice in the real world by using an Arduino, an ultrasonic sensor, and a buzzer at a distance in regions where crossings are not functioning well, in rural areas, or in urban areas with dense populations.

V. RESULT AND ANALYSIS

The solution that is suggested makes use of ultrasonic sensors. The sensor is kept out of the path of the train by a barrier on the track. An ultrasonic sensor was employed as a proximity switch to warn individuals when a train was approaching from a distance of approximately 500 meters away. The ultrasonic sensor automatically blinks a red light and makes a buzzing sound when something blocks it. Ultrasonic sensors generate high frequency sound pulses, and they then examine the echoes they receive. On a railway track, it uses this sensor to find the train. It can greatly reduce railway accidents, resulting in a smoother operation of the railway and more financial success for the railway industry.

VI. CONCLUSION

This system employs a Proteus simulation with an Arduino-based safety system so that obstacles can be informed through an alarm with the help of a buzzer by detecting trains through ultrasonic sensors, preventing accidents on railway tracks and providing safety on tracks that greatly assists the railway company and the general public in maintaining the security on tracks. The goal of this project was to develop a low-power, reasonably priced onboard detection system, and embedded system to help raise the bar for rail track safety and prevent train accidents. The result shows that the dependability of railway safety systems will increase thanks to this brand-new, cutting-edge technology. These capabilities can be used in real-time applications to drastically lower the possibility of mishaps.

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