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A MODEL OF ACCIDENT AVOIDING SYSTEM FOR RAILWAYS

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Abstract—Accidents along railway railings are becoming more frequent. Indian railways manage the fourth-largest national railway system in the world, with 68,043 kilometres of route. India has 19 railway zones, including the Metro Railway. It is one of the busiest networks in the world. Moving 1.208 billion tonnes of freight and 8.086 billion passengers each year. After many technological changes, people have different means of transport like Bikes, Cars, Buses, Airlines, and Railways. Among those railways is very convenient and comparatively cheap moreover time-saving transport. An entire nation will benefit when there is little improvement in this area. Accidents will occur due to poor maintenance. Many of those take place due to Collision, if there is any fault or cracks in the track and any obstacle in Infront of the train. This paper deals with the problems occurring in railways that can be resolved. This effective prototype effectively monitors and observes the fault in track and object to stop accidents using IR sensors. And train runs automatically using solar Energy using a Solar plate and Dc Motor. And moreover, we are using the GSM module and GPS. Safety must be the top priority in train running and it plays a crucial role in the safe running of trains in our country. Already many systems are existed to avoid accidents, even though an attempt is made in this project work to study the subject of train accidents avoiding systems to enhance the technology further. The Train Collision Avoidance System (TCAS) is a major subject to detect Due to excessive speed and train collisions in the station area, unsafe situations can occur. The advanced accident prevention methods must be incorporated those measures under which the trains will be in constant communication with the protection systems through electronic communication systems. Although Indian Railways have safe running devices, we have made an effort to cover a few more important features 1 – to detect the track break in running rail track, 2 – object detection in between the tracks with auto control, and 3 – auto stop when train detects red signal present over a trackside signal post. These are the three important parameters incorporated in our project work and for a live demo, a mini model train will be constructed over which all required sensors and their control circuits will be installed to prove the theme practically.

Keywords—Collision, Object, Fault in Track, IR Sensors, Solar Plate, DC Motors, GSM, GPS.

I. Introduction

The mainstay of trade and the economy in the majority of nations is rail transport. Railways provide a cost-effective way to move goods over land. The railway tracks are large portions of the system that provide smooth and difficult surfaces on which the train's wheels roll with a minimal amount of friction. Indian railway maintenance and fault finding are currently done manually, which is laborious. This paper proposes a microcontroller-based real-time fault observation system that can address the drawbacks of manual monitoring and maintenance procedures. The concept presented in this project work is to prove the technology of the Autonomous train that is intended to avoid accidents without interference from the driver. In this regard, a prototype model is designed for a live demonstration. Automatic accident-avoiding Autonomous trains operate based on the condition of unexpected situations like obstacle sensing between the running tracks, track break detection, and controls automatically according to the trackside signals. There are many safety parameters to be considered for automatic accident alerting cum preventing systems in trains, but here since it is a prototype module, few important situations are considered to stop the train automatically. One main important aspect of the system is that the train will be stopped automatically when it detects a red signal over the trackside signal post. To prove this concept, one small signal post will be installed on the side of the track and it contains red and yellow signals. Here the running train will have a wireless communication system between the signal post and train control circuit, such that the train will be stopped at a red signal. When the red signal turned in to yellow, automatically, the train moves further. The suggested system is trustworthy and cost-effective. On the outside surfaces of the track, the sensing modules are alternately positioned and evenly spaced. The results from various modules inserted into the controlled by a microcontroller will process the signals further and determine whether there is a rail fault. The train continuity sensor designed with IR sensors and TC 567 monitors the track continuously. If the system detects a track break, the trail will immediately stop at that location and information will be sent to the relevant cell phone belonging to the relevant authority, such as the station master.

II. Literature Survey

Every day, the entire track is examined a foot. The various kinds of patrolling include gang patrol during unusual rain, night patrol during the monsoon, weather patrol for welded tracks, security patrol, watchmen at risky locations, and weather condition patrol. Gang surveillance is the name for foot patrols along railway tracks during inclement weather. The use of robust digital signal processors and image processing methods [1] is being researched as a potential solution for the problem of rail crack detection. This system uses methods such as Edge detection associated with morphology and image segmentation, both of which need a lot of processing power, even though it provides excellent accuracy. The mechanism is slow and wastes a lot of time and power. A recent analysis looked into the use of microwave antennas, such as horn antennas, for crack detection [2]. In tests conducted in science labs, it was discovered that this method produced incredibly accurate results. However, sadly, it requires spectrum analyser's, which are both expensive and unable to be mounted on a moving mechanism. because of their fragility. based on eddy currents techniques are used to overcome the shortcomings of ultrasonic and microwave technologies [3, [4, and] [5]. However, they have the flaw of being terrible. The low overall speed makes the same less usable. The infrared sensing technique is used in the vast majority of research on crack detection [6]– [8]. It was initially believed to be the most effective method for crack detection because it is a method that is widely understood, but later it was discovered to be susceptible to outside disturbances and was therefore deemed inaccurate. While ultrasonic techniques [9]–[11] address some of the aforementioned issues, They are only able to examine the track's core because they are unable to identify surface and near-surface cracking, which is thought to be where the majority of faults are located.

III. Proposed System

A. IR Sensors

As per the circuit diagram and priority wise, the process begins with a track break detecting circuit, this circuit and object detecting circuit both are constructed with IR sensors and IC's 567. Though the circuits are similar, applications will differ. It is necessary to lay down a metal track over the wooden plank over which the model train will be moving in both directions according to the signal provided by the command keys in order to prove the concept practically. In order to detect the track break, a single circuit with an IR signal-receiving LED and an IR signal-transmitting LED placed side by side is used. Here at one end of the track, the running track will be cut into two pieces for demo purposes. The sensors along with its trigger circuit built with IC 567 will be arranged at the bottom side of the moving mechanism. The sensor position is important here such that both sensors will be placed to detect the continuity of the track. The IR energy radiated from the IR signal transmitting LED will be striking the running track. As the train moves, the IR energy will be reflected back continuously as long as the track is continued. The reflected energy will be detected by the IR signal detector and as long as the sensor gets the reflected signal, the IC output remains in zero state. When the train reaches the point where the track is broken, there the IR signal will be transmitted in a straight line through the broken track, and at this point, the signal will not be reflected back and the circuit output will become high. Based on this signal, the main processing unit is programmed to stop the train automatically, the alarm will be energized and information will be transmitted to the concerned mobile phone through GSM. Once the alarm is energized it remains in energized condition until the reset button is activated.

Similarly, another circuit is constructed for detecting the object that is present between the tracks. Whenever the running train detects any object in its way, immediately the train will be stopped and information will be transmitted to the concerned station master or concerned authority through the GSM module. Here GSM module is interfaced with the main processor and this entire circuit is designed as battery-operated such that the train carries this main processor. The following is a detailed description of the above circuits.

GPS is included in this prototype to find the exact location of the fault to the concerned person or nearby station master it makes them easy to reach the destination in a short period of time.

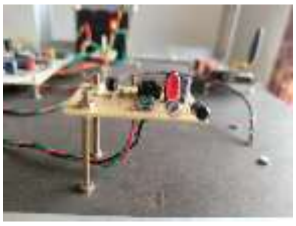

Fig 3.1 Object Sensor

Fig3. 2 Track Sensor

B. Moving Train Mechanism

The demo module is constructed with a small trolley that is supposed to be run over a mini track laid over a wooden plank. This trolley is having four grooved wheels such that the trolley will not deviate from the track. The train track is simulated with aluminium channels and these channels are laid over a wooden plank. As the trolley wheels are having 3mm groves cut in 3mm depth, the trolley will not deviate from the track. The wheels are coupled with the chassis, as the trolley is designed to drive through a dc motor spur gears are used and are coupled with the Axel mechanism. Here 2 similar types of spur gears are used with the same no. of teeth. One spur gear is coupled with the motor shaft and another spur gear is coupled with the axel mechanism.

Fig 3.3 Moving Track

C. DC Motors

DC motors are common, affordable, compact, and powerful relative to their size. They are the easiest to manage. Only two signals are necessary for one DC motor to function. Direct current voltages are fed into DC motors where they are transformed into rotational movement. Typically having two wires, DC motors can be run directly from a battery or another DC power source. A driver can also power a DC motor. circuit, which manages the speed and direction of the motor. Due to their low price, variable speed, need for a higher starting torque that is lower than running torque, frequent start/stop cycles, and the need for closed-loop positioning, DC motors are frequently utilized in robot applications. DC motors used in robotics typically have a voltage between 6 and 12 volts. The power window motor's gear shaft will unquestionably boost the torque of the motor.

Fig 3.4 DC Motor

Table 1 Motor Specifications

Power	200W
Voltage	12 V
No load Current	0.7 A
Current in loaded Condition	12 A
Weight	2.7 KG

D. Main Processing Unit

The circuit is constructed with an 89C52 controller chip this also an 8-bit IC and has 8kb memory in the ROM internally. The entire train control circuit will be controlled automatically according to the input data given by the sensors and with the help of four control keys interfaced with this controller chip. The train can be controlled manually.

Fig 3.5 Main Processing Unit

E. Software Program

KEIL Micro vision software is used to program the chip. The program is prepared in assembly language using an embedded C platform. And the prepared program will be dumped into the internal ROM of the controller chip using a USB cable.

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F. Battery

G. Solar panel

The solar panel used in our project work can generate a maximum current of 0.7amps under the bright sun at 12 volts. The sun's ultraviolet energy will be converted into electric energy using photo voltaic cells. Each PV cell can generate 1.2-volt dc. The current output of the cell depends upon the size of the PV cell. To generate the required voltage and current number of such If cells are connected in parallel, the current output will double. The voltage doubles when two cells are wired in series. The results of the panel is used to charge the battery for this purpose 12volt 2AH Lead-acid rechargeable battery is used.

There is a buzzer in this prototype that gives an alarm to the driver present on the train.

Table 2 Solar Panel Specifications

Power	200W
Voltage	12V
Maximum Current	9A

Fig3. 6 Battery

The intermittent nature of renewable energy sources can be made up for by an effective battery storage system. 12 A is the total electrical load. So, a 24 V, Choose a 30 Ah lead acid battery. The vehicle requires a low-speed battery; hence a lead acid battery is selected as indicated in Figure 2. Compared to other battery kinds, it is affordable.

Table 3 Battery Specifications

Voltage	12V
Capacity	26Ah
Maximum Charging Current	7.8A
Weight	8.8kg
Maximum Discharging Current	260A

Fig 3.7 Solar Panel

H. GSM Module

Fig 3.8 GSM Module

I. Mathematical Equation

$F = 1/R_T C_T$

R_T = Resistor for Timing

CT = Capacitor for Timing

Battery backup time = Battery rating / Entire system current consumption2 / 0.7 = 2.8 hours

P = V I 12 0.7 = 8.4 watts

IV. Circuit Diagram

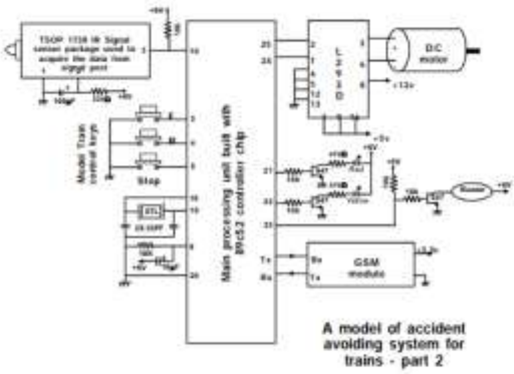


fig 3.9. A model for an accident-avoidance system for trains

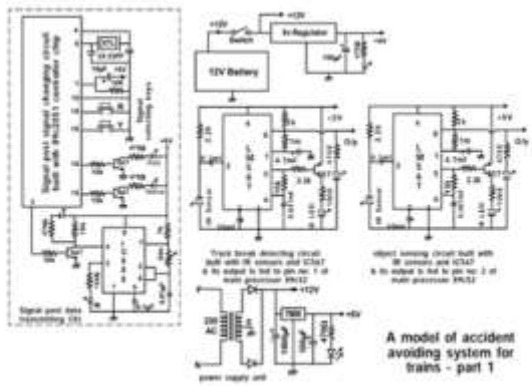


Fig 3.1.0 Block Diagram

Fig 3.1.1 Train

Fig 3.1.2 Track Break

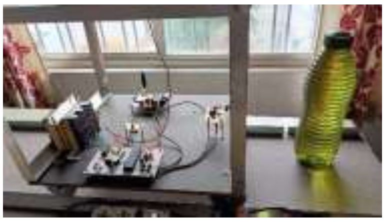
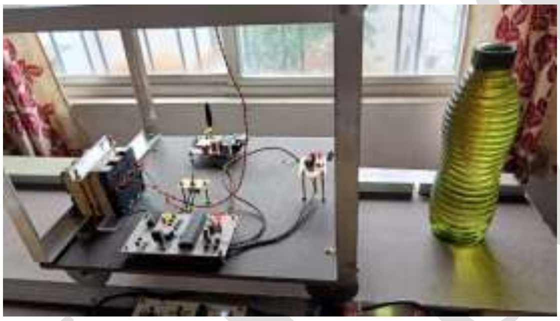


Fig 3.1.3 Object Detection

IV. Result & Analysis

This prototype is more efficient than previous methods. It gives 95% accuracy; it is ready to implement in Indian railway systems.



4.0 Object Detection

V. Conclusion

Finally, a mini model of a train, the project work “A model of accident avoiding system for trains” is completed successfully and the results are found to be satisfactory. We discovered during our trail runs that it is quite challenging to convey data from the signal post along the track because there aren't any appropriate sensors or circuits accessible. In order to accomplish the desired outcome, we created our own circuit after doing numerous tests with various circuits. The transmission of the digital data generated by the microcontroller chip is the circuit's ultimate objective. Here RF communication is also recommended, but when signal posts are nearby each other, it may be a major difficulty that the signals may collide with each other and the system may not display the proper signal. The aim is to send information when the train reaches near to the signal post. In this regard, we discovered that the data must be transmitted in a single direction, not an omnidirectional one like RF transmitters do. As a result, the IC 555 is used to build the IR signal transmitter circuit. Since it is a prototype module, an entire circuit including signal posts is arranged over a small wooden plank over which a train track is also arranged for a live demo. Because of the necessity of building and packing the entire system, short-range communication is preferred because it requires less current to be pumped into the IR signal-transmitting LED.

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