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IR SENSOR BASED ELECTRIC LOCOMOTIVES FOR OBSTRUCTION OF COLLISIONS

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ABSTRACT

In today's world safety and security plays an important role in every transport medium, especially in the case of railways. In this thriving society, more and more locomotives are produced to meet the increasing demands of people from all corners of the world. Here comes the necessity to provide more and more safety and security features to them. This paper aims to design an embedded system for locomotive safety. This system detects the obstruction of trains in front of them and protects the people inside the locomotive and provides alert information in the form of alarm through buzzer during the critical situations. And also gives the signal through signal LED. Automatic track switching is possible with the help of RF communication. An IR Sensor is used to detect the static obstacle in front of the vehicle and the vehicle gets stopped if any obstacle is detected. This may avoid accidents due to collision of vehicles with any static obstacles.

***Keywords**: RF communication, Locomotive, Collisions, IR Sensor, LED.*

I. INTRODUCTION

Railways are the convenient, reasonable and popular node of transport in almost all major cities of not only in India but also all over the World. Indian Railways is fully owned and operated by Ministry of Railways, Government of India. The Indian Railways has the world's fourth largest railway network in the world, after that of the United States, Russia and China. Annually 11 million passengers travel by train. Indian Railway (IR) is a vast system comprising of nearly 64,000 route kilometers with over 7000 block stations and holding nearly 9000 locomotives, 43500 passenger coaches, 7500 electrical and diesel multiple units and 220 thousand wagons. Like any other transportation system, it is technology intensive not only for ensuring high productivity of its assets but also for safety in train operations. But the safety on the railways is the end product of the coordination among all the factors. The recent rail accidents have drawn the attention of everyone in the country. The total number of accidents and their causes in Indian Railway were found in decreasing trend over the years but the number of persons killed and economic loss associated per accident showed an increasing trend indicating an increase in severity of the railway accidents.

With the accrued demand for railway services, the overall railway infrastructure has been a pace developing within the past 20 years, together with its communication systems Walkie-Talkies or different communication devices.

When the train met with an accident maximum people lose their lives. It is very difficult to avoid to such train accidents because of the speed of train is very high and it requires some time to control it. Now a day's in India most of the train accidents were occurred with negligence of humans and without proper communication from Train Traffic Control Station (TTCS).To prevent this problem we need to use a system provided with sensors which will identify the opposite train in the same track within a short time.

This paper is fully concentrating on avoiding train collisions and ensures passenger's safety through embedded system integrated with IR sensor based control system inbuilt in the train. The design cost is low and the use of the designed system reduces collision between opposite trains on the same track. Automatic track switching is possible with the help of RF communication. Automatic braking system is also available.

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II. METHODOLOGY

This system performs four major functions anti-collisions of locomotives, obstacle detection, and track switching and speed control of train.

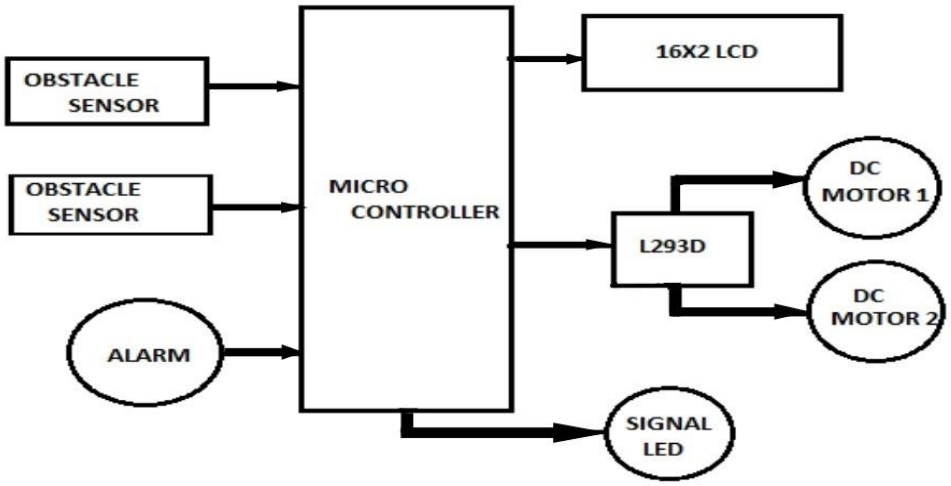

Fig 1: Block diagram of proposed system

For automatic track switching, we are using RF and IR communication. The train tracks are partitioned into sections with individual track portion number. At whatever point a train enters a portion of the track, the track number of that fragment of track is perused from the Radio Frequency Identification (RFID) labels present toward the start of each section of track. This track number per used by the RFID tag is stored and after that given to Radio Frequency (RF) Transceivers. The RF correspondence is built up among the adjoining trains, which are in the range through a calculation, so the track numbers are shared. Now the track number of its own from RFID reader is compared with the track numbers of other trains from RF Receiver. Upon detection of same track number the system will alert the loco pilots.

III. MATERIAL

1. Power supply:

The input to the circuit is applied from the regulated power source. The microcontroller power is of 5V. The A.C. input i.e., 230V after the mains supply is step down by the transformer to 12V and is fed to a rectifier. The production gained from the rectifier is a pulsating D.C voltage. So in order to get a pure D.C voltage, the output voltage from the rectifier is fed to a filter to remove any A.C components present even after rectification. Currently, this power is given to a voltage regulator to obtain a pure continuous dc voltage.

2. Voltage regulators:

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. In this project, power supply of 5V and 12V are required. In order to obtain these voltage levels, 7805 and 7812 voltage regulators are to be used. The first number 78 represents positive supply and the numbers 05, 12 represent the required output voltage levels.

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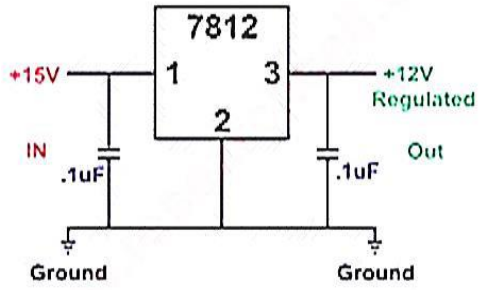

Fig 2:7812 Voltage Regulator

3. Liquid crystal display:

Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrix displays is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

Fig 3: LCD Module

4. Micro controller:

Micro controller is an integrated circuit or a chip with a processor and other support devices like program memory, data memory, I/O ports, serial communication interface etc integrated together. Unlike a microprocessor (ex: Intel8085), a micro-controller does not require any external interfacing of support devices. Intel 8051 is the most popular micro-controller ever produced in the world market.

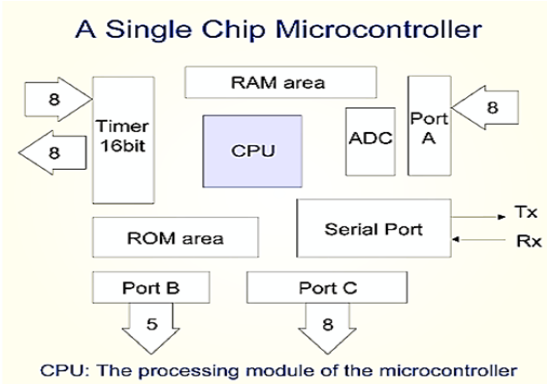

Fig 4: A typical micro-controller device and its different sub-units

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5. IR sensor:

An infrared sensor is an electronic device, which 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 type of the sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations.IR Sensor is shown in the fig (4.7). These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photo-diode which is sensitive to IR light of the same wavelength as that emitted by the IRLED. When IR light falls on the photo-diode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

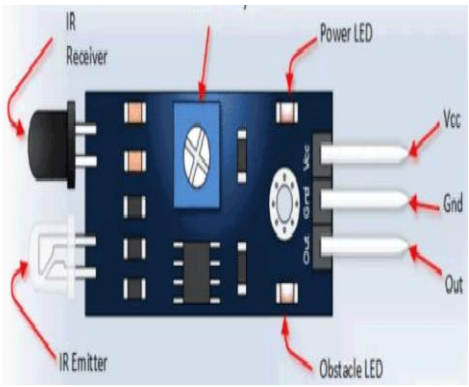

Fig 5: IR Sensor

7. L293D driver:

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high voltage loads in positive-supply applications.

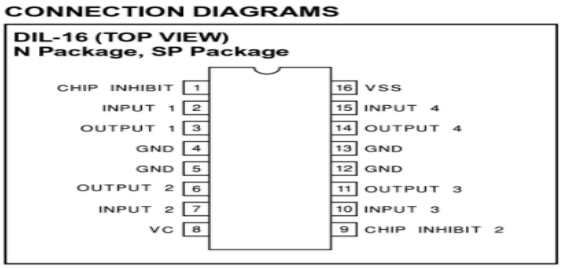

Fig 6: Pin out Of L293D

8. DC motor:

Motors convert electrical energy (from a battery or voltage source) into mechanical energy (used to cause rotation). When a wire that carries current is placed in a region of space that has a magnetic field, the wire experiences a force.
Force = (current) x (wire length) x (magnetic field)

The size of the force, which determines how fast the motor spins, depends on the amount of current in the wire, the length of the wire, the strength of the magnetic field

- The direction of the force, which determines which direction the motor spins, depends on the direction of the current in the wire o the direction of the magnetic field.

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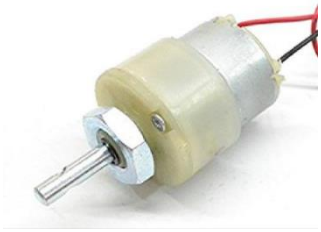

Fig 7: DC Motor

9. BUZZER:

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as microwave oven, or game shows. It can be operated from stepped-down AC line voltages at 50 or 60 cycles. It commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a present time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermitted buzzing or beeping sound.

Fig 8: Buzzer

10. Servo motor:

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system.

IV. EXISTING SYSTEM

Indian Railway has implemented Anti Collision Device (ACD) patented by Konkan Railway. The ACD system is based on GPS for positioning and track detection. This had its own inherent problems as it is based on GPS-Standard Positioning, GPS service or coarse acquisition. The best possible horizontal accuracy is 10m. This is inadequate for detection of rail tracks separated by a distance of 10–15 feet. The ACD system though in use with the Indian Railways, has its own inherent problems in Station Sections due to its design concept of using GPS for track detection that is not viable. Shadowing (near mountains) is a problem in GPS. The Konkani Railway route suffers from landslides in the monsoon season, which has caused fatal accidents in the recent past. The ACD does not provide proper communication between the trains and stations because it sees radio modems. To overcome this problems Kankan railways also introduce a Zigbee and infrared sensors based concept. This one also fails because it has limited range of signal coverage. Instead of this they used geographical sensors through satellites for communication. But it is very costly and complicated to implement. And also it fails to work on curved tracks.

V. PROPOSED SYSTEM

After the power supply is switched on, IR sensor transmitter fitted on the lamp post will be emitting radiations. The IR sensor receiver fitted on the train receives the radiation. It is used to determine the track in which the train is travelling.An IR sensor is fitted in front of train which acts as obstacle sensor and avoids collisions. The sensor connected to train control block placed on train. IR sensor emits the waves and detects the

object distance, if the object distance is lesser than the safety distance value it automatically decrease the speed of train and finally it stops. This avoids the accidents near gates and suicides at tracks.

When two train's approaches on the same track i.e., curved, it works in line of sight and sends signal back to the controller using IR communication. As a response to this signal controller reduces the speed of the train in curve and finally it stops. IR sensors are placed for locating the train location and it is monitored on LCD display, this helps in the proper location of every trains and it avoids collision of the trains.

During train collision condition, the train accident prevention system works efficiently. When both the trains are on the same track, the alarm fitted inside the train starts to sound. Servo motor is used for the track changing mechanism, sensors are placed in the tracks it detects the train presence in the track and signal is sent to the system using RF communication, and railroad switch is connected to the servo motor which rotates motor at a particular angle leads to the track change and other train is moved to secondary track. It leads to the decrease of man power and also the human error.

VI. RESULT & DISCUSSION

The prototype of the proposed system using IR sensors system has been shown in figure. 6. This system has been tested by implementing the collision avoidance environment in train on the same track. The proposed Train Anti-Collision System consists of a self-acting micro-controller and IR sensor based train anti-collision detection system which works round-the-clock to avert train collisions.

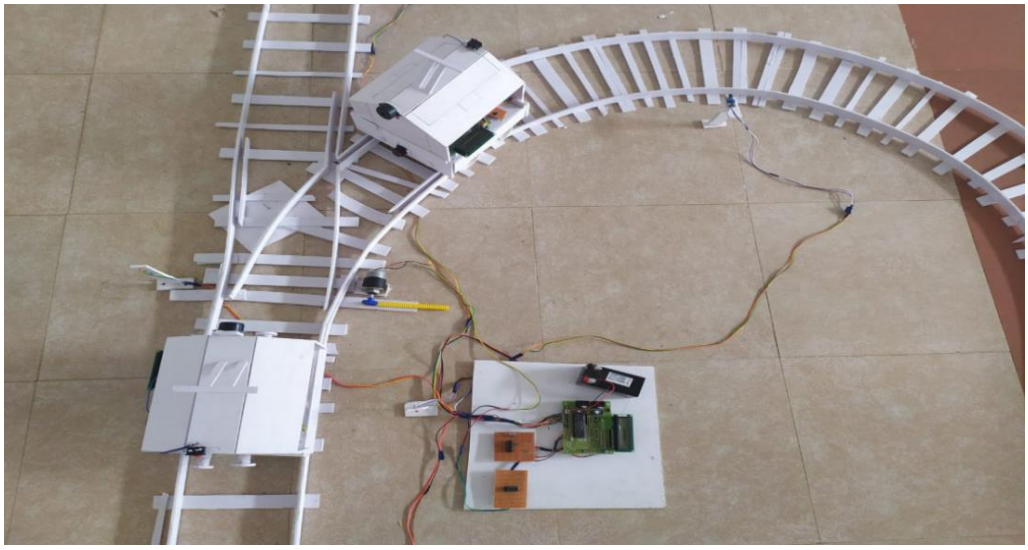

Fig 9: Prototype model of Proposed System

The project undergoes with three cases such as detection of obstacles, anti-collisions and track diversions. We observed the three cases in this work.The messages related to all the operations that occur in both train are displayed on LCD screen connected to the microcontroller.

CASE-1: Obstacle detection:
Here the card board in-front of the train acts as an obstacle and IR sensor detects the obstacle at a distance of 1meter in our application. It gradually reduces its speed slowly and stops at a distance of 30cm.This will reduce the number of accidents near gates and suicides on the tracks.

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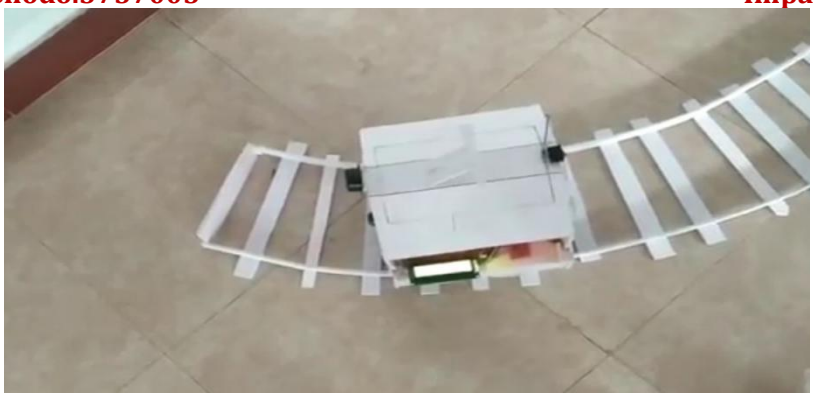

Fig 10: Detection of Obstacles

Fig 11: LCD display

Case 2: Anti-collisions of Locomotives:
When two trains met on the curved tracks, the sensors will send the signal to the micro controller and automatically avoidance of collision occurs. The two trains stopped at a distance of 10cm in curved paths.

Fig 12: LCD display

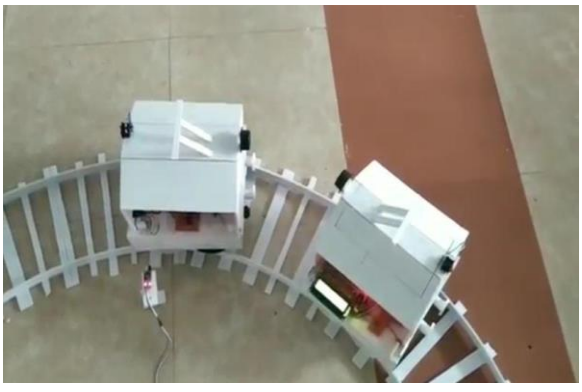

Fig 13: Trains anti-collision

Case 3: Track Diversion using RF and IR communication:
When two trains meet at a same track, for efficient clearance of track we divert one train to another track. This will utilize the time.

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Fig 14: Track Diversion

VII. CONCLUSION

This innovative technique of early sensing of any possible collision scenario and avoiding it, we demonstrate that it is possible to improve the overall safety of the railway system in India. The main intension of the system is to prevent train collisions. By using this system many human lives can be saved. Without any human involvement the trains will automatically stops, if any sensors get activated. This system can work in any atmospheric conditions. We believe that success depends on both the railway industry and the regulator working together to achieve the common goal.

VIII. ACKNOWLEDGEMENTS

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