Section A-Research paper

AUTOMATIC FIRE CONTROL SYSTEM IN RAILWAYS

[1]Dr. B.Vidya Sagar, [2]K.Sai Priya, [3]B. Kurmi Naidu, [4]S. Sai Sagar, [5]M. Shivakanth Reddy, [6]M. S. Sujatha

[1,2,3,4,5]Teegala Krishna Reddy Engineering College
Hyderabad, Telangana, India
Sree Vidyanikethan Engineering College (Formerly), Mohan Babu University, Tirupati, India
vidyasagar@tkrec.ac.in

Abstract. The Present project will automatically help the railways to safeguard from Fire Accidents in a step-by-step process. When a fire occurs, the sensor will detect and starts alerting the security people. We designed four stages for controlling and monitoring. The siren will be turned ONin the first stage, in the second stage Blinker, in the third stage water flushes, and in the fourth stage, the train stops automatically by using LM3914 with LM35 Heat sensors and RF Wireless technology with relay switching is interfaced for the circuit.

Keywords:RF Technology**,** LM3914 IC, LM35 Heat sensors

1 INTRODUCTION

Fire accidents in trains are one of the most dangerous disasters to human lives and loss of costly components in Railways. Fire in a moving train is threatening because it quickly spreads to other coaches due to the interaction with air present in the surroundings. Automatic fire control in railroads is the topic of this study [1]. As we can see, there are frequent train fire catastrophes that result in fatalities for passengers. To overcome this challenge, we designed an autonomous fire control system. This project makes use of sensing components to measure temperature and fire [2]. Additionally, Wireless RF technology is being used to continuously manage the fire and check the temperature inside the train compartment [3] [4]. The system will use the Temperature Sensor to determine the temperature, and it will use the Siren and Blinker to inform those inside the compartments [5]. Water Sprinklers are utilized to put out the fire In the entire functioning stages, an LM35 Heat Sensor, relay switching is interfaced and operated [6] [7].

The automatic fire control system applies to theatres, museums, exhibitions, complexes, Historical and cultural artifacts, and huge regions where there are high-rack warehouses, workshops, underground parking lots, etc. We use several electrical components in this project i.e. Step-down transformer, LM3914 IC, LM35 Heat Sensor, Relays, Encoder, Decoder, RF Technology, and Optocouplers [8].

A T/F is an electric device that can change the voltage without changing the frequency. Without any electrical contact between them, the electrical energy is transmitted from one circuit to another [9]. This is designed to alter the Voltage output between the circuits while keeping the current's frequency constant. This technique is used to step up the voltage and afterward step down the current to lower it. This shows that the current flowing via the overhead wires is frequently little and has a wide dispersion across the country.

. A step-down T/F is a static device that has low current (LC) and high voltage (HV) from the transformer's principal side to the secondary side'sHigh current (CV) and low voltage (LV). For a step-down transformer, the voltage ratio is roughly inversely proportional to the transformer turns ratio(n):

$$n = Npi/Nse = Np/Ns \quad (1)$$

Where NPS stands for the number of turns on the primary (LV)and secondary (HV) sides, representatively, VPS stands for, whereas voltage energy flow from the HV side to the LV side because the main side (HV Side) of a step-down transformer has more turns than the secondary side (LV Side). Stepping down the primary voltage (input voltage) to the secondary voltage (output voltage). This equation can be changed to include the output voltage formula (i.e., Secondary voltage). It is possible to refer to the following formula as the step-down transformer formula:

$$Ns*Vp/Vs=Vs \quad (2)$$

The transformer in an electronic device is referred to as the low-voltage application a low-voltage value is needed to supply the electrical circuits (for example,5V or even low values).

The temperature sensor LM35 measuresexternal heat and gives the outputs as a signal in an analog form that is proportional to the immediate temperature is simple to interpret the output voltage to obtain a temperature reading in Celsius.Several forms of There are heat sensors available.a few works with hot temperaturemeasuresand Certain sensors are inappropriate for this project. The LM35 element is rated to operate over a range of −55°C to 150°C [10] [11].

The LM3914 is an integrated circuit (IC) that has outputs that can power up fluorescent displays, LCDs, or LEDs.The device can be used, for instance, as a voltmeter thanks to the direct scaling of the output thresholds. The initial configuration offers a scale with ten steps that can be expanded to 100 pieces and ten vacuum floors with another LM3914 IC.

4.1 DESCRIPTION: -

The LM3914 is an integrated circuit that senses analog voltage levels and drives 10 LEDs providing a linear analog display

5. RELAYS

A switch that is electrically actuated is called a switch. It consists of several input terminals, several functioning contact terminals, and one or more control signals. There could be any quantity of contacts on the switch relays used to open or close. There could be any number of contacts on the switch. Relays are used to open or close electrical circuits as well as protect electrical devices.

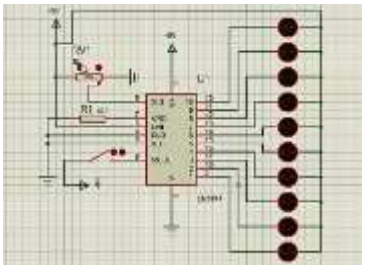


FIG:6.IC PIN CONNECTIONS TO LEDS

An electromagnet, armature, spring movable contact, and stationary contact make up an electromagnetic relay. The high power required to directly control a load may be handled by a relay, but the difference is in the voltage.

1. Encoders

The encoder is a piece of technology that is used to encode the signals with the help of signals send by the transmitter.

2. Decoders

The decoder is an electronic device that is used to decode the signals which are sent by the receiver.

An RF module is also called a radio frequency module. It's a tiny electronic gadget that's utilized to transmit and receive signals with the help of a transmitter and receiver between two devices.

Another name for an optocoupler is a photocoupler or an optoisolator. It is an electronic component that uses light to transmit electrical impulses between two shielded circuits. High voltages cannot damage the system entering the signal thanks to opt-isolators. optoisolators that are rapidly available in the marketplace can tolerate input-to-output voltages of up to 10kv and voltage transients of up to 25kv/s. To provide insulation between low and high-voltage circuits, optocouplers can either be employed alone as a switching device or in conjunction with other electrical biases. These gadgets are often used to switch the DC and AC power input and output of microprocessors. In this system, there are two components: an automatic control unit and a monitoring section

9. Automatic control unit

The step-down transformer, a sensor system, an LM3914 integrated circuit, a transmitter section, and a relay's sequential switching system are the automatic control unit's main systems.

In this system, the needed power is supplied by stepping down the system voltage using a step-down transformer. An LM3914 integrated circuit temperature level in the compartment is shown by the LED and a heat sensor in the sensing system detects an increase in temperature in the compartments when fire accidents occur. To notify the passengers, a siren is activated. Fire sensors also detect a fire within the compartment, and this information is conveyed through an RF module. The transmitter and receiver sections of an RF module. The transmitter section collects data from heat sensors and transmits it to the receiver section, which is in the monitoring section and locomotive, so that the monitoring section and locomotive may take appropriate action to protect the passengers.

Sequential relay switching is utilized to turn on the water pump, blinkers, and train brakes all at once. The water pump will start to circulate water throughout the cabin as the relay-controlled automatic braking system stops the train.

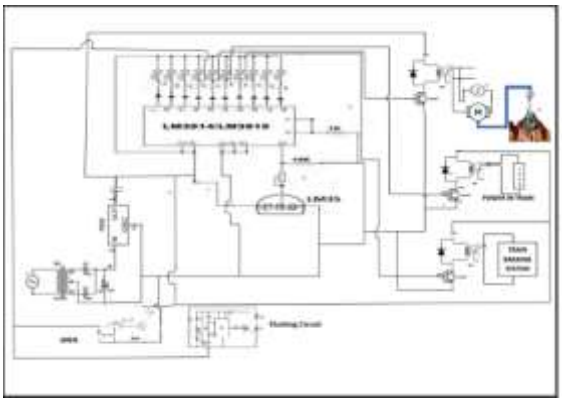


Fig:11Control unit Circuit diagram

10. Monitoring section

The receiver section is another name for the monitoring section. Data from the RF transmission module is received by it via an RF reception module. It informs the railroad safety measures to control fire accidents and save the lives of passengers by displaying the serial number of the bogie in which the fire accidents occur.

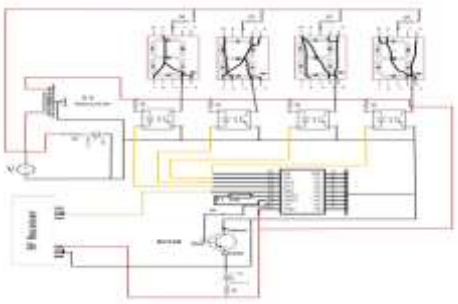


Fig:12.Schematic diagram

Fig:13. Monitoring circuit board

11. Block Diagram

Fig:14.Block diagram

12. SYSTEM OVERVIEW

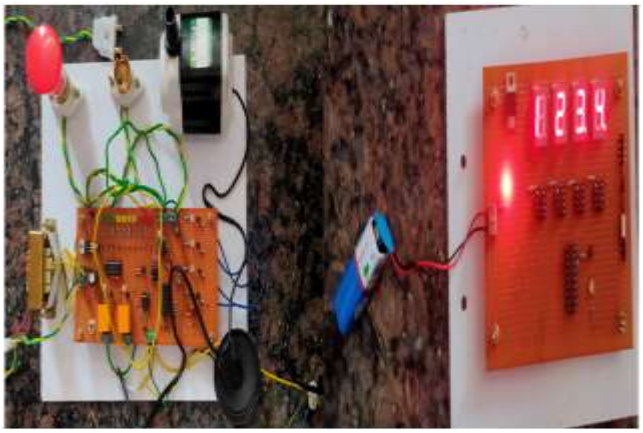


Fig.15.Automatic fire control unit and monitoring section.

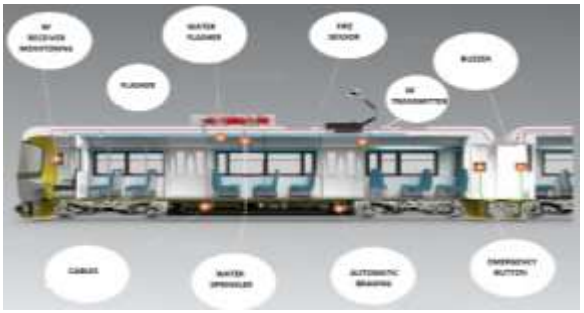
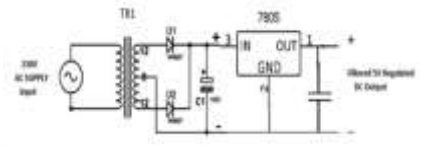


Fig.16.Installation of circuits in a train compartment

13.Circuit diagrams



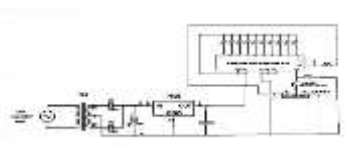


Fig.17.5v regulated supply circuit **Fig.18.Temperature indicator circuit**

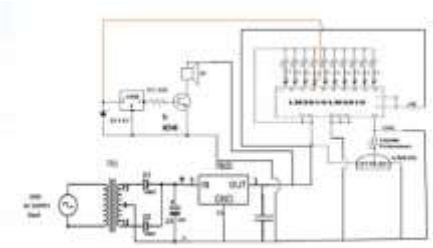


Fig.19.Siren circuit

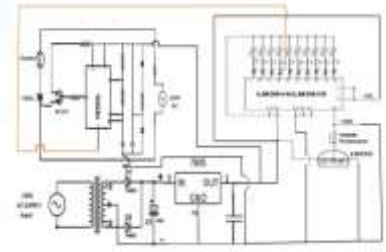


Fig.20.Flasher and Relay circuit

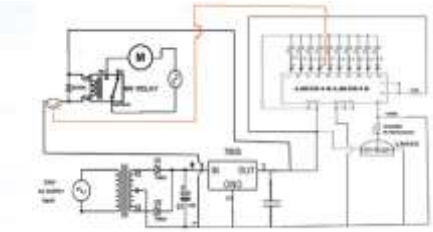


Fig.21.Water sprinkler circuit

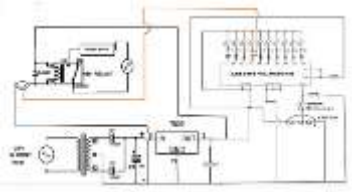


Fig.22.Train Breaking circuit

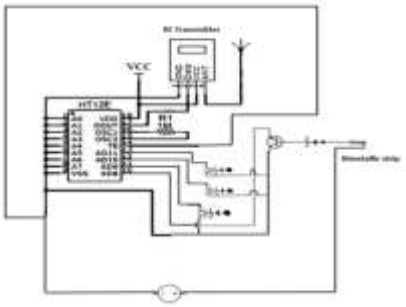


Fig.23.RF Transmitter circuit

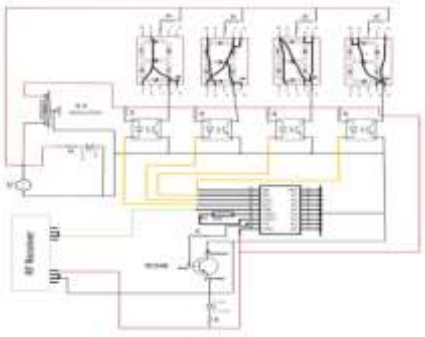


Fig.24.RF Receiver circuit

14.RESULT

As fire accidents occur the heat sensors sense the heat and the fire detector detects the fire and indicates the temperature, simultaneouslysiren and blinkers will be turned on to alert passengers, relays get operated and the water pump is turned on then the water sprinkling starts the same time train get stops by breakings. Hence, the fire in the train gets controlled and stops the spreading of the fire

15. CONCLUSION

This essay demonstrates the planning and execution of automatic fire control systems in railways at low-cost and trustworthiness. Using RF technology, which is completely wireless. this system is implemented mainly with electrical components, like heat sensors, fire detectors, relays, etc. heat sensors, fire detectors, and water storage is allotted at every compartment in railroads. so that whenever fire detects it is controlled. This is a more condensed version of the project and implemented and tested with success in this document.

16. REFERENCES

1. Devan, P. ArunMozhi, et al. "Fire Safety and Alerting System in Railways." *3rd IEEE International Conference on Recent Trends in Electronics, Information, and Communication Technology, 2018 (RTEICT). IEEE, 2018.*
2. Pandey, Sumit, et al. "Automatic fire-initiated braking and alert system for trains." *Second International Conference on Computer and Communication Engineering Advances 2015 IEEE, 2015.*
3. Peacock Richard W. Bukowski, VytenisBabrauskas, Paul A. Reneke, Walter W. Jones, and Richard D.. "Concepts for fire protection of passenger rail vehicles: past, present, and future Inflammable Materials 19, no. 2 (1995): 71-87.
4. 4. Wang, W. Q., and Liu, X. L. (2013). An investigation of China's standardization of the use of fire detectors in rail vehicles. 240–244 in Procedia Engineering, 52.
5. 5. Raman, R. R., Kumar, S. S., M. P., and Ramasamy, R. P. (2013). Using a Zigbee wireless sensor network, fire mishaps on moving trains can be prevented. 3(6), 583-592, International Journal of Information and Computation Technology.
6. Lee, T. S., Moon, Y. H., & Hong, H. S. (2004). A Study on the auto fire-extinguishing system in the subway train. Within the KSR Conference Proceedings (pp. 168-173). Railway Society of Korea.
7. Sathya, M. S., Khan, J. A. J., Velmurugan, M., &Kumar, M. A. A. (2020). FORESTALLING FIRE ACCIDENT IN TRAIN.
8. R. Mundra, A. Srinivasulu, C. Ravariu, A. Bhargav, M.Sarada, "Real Time Driver Alertness System Based on Eye Aspect Ratio and Head Pose Estimation", in proc.of the International Conference on Smart Technologies in Urban Engineering, 29 Nov. 2022, vol. 536, pp. 707-716. doi:10.1007/978-3-031-20141-7_63
9. Liu, Y. Y. (2020, September). Analysis of Taihe East Station's drainage, fire suppression, and water supply system design aspects for the Shanghai Railway. Earth and Environmental Science Conference Series, IOP *Science* (Vol. 568, No. 1, p. 012022). IOP Publishing.
10. S .Sreelakshmi, M. S. Sujatha, Jammy Ramesh Rahul, " Improved Seven level Multilevel DC-Link Inverter with Novel Carrier PWM Technique", Journal of Circuits Systems and Computers, DOI.org/10.1142/S0218126623501086, 2023.
11. D.K.Gupta, A. Srinivasulu, et al.,"Load Frequency Control Using Hybrid Intelligent Optimization technique for Multi-Source Power Systems", Energies, 2021, 14(6), 1581; doi:10.3390/en14061581.ISSN:1996-1073.
12. S .Sreelakshmi, M. S. Sujatha, Jammy Ramesh Rahul, " Multi-level inverter with novel carrier pulse width modulation technique for high voltage applications " , Indonesian Journal of Electrical Engineering and Computer Science Vol. 26, No. 2, May 2022, pp. 667~674.
13. D.K.Gupta, A. Srinivasulu, et al.,"Hybrid Gravitational-Firefly Algorithm based Load Frequency Control for Hydrothermal Two-area System", Mathematics,2021, 9(7), 712; doi:10.3390/math9070712
14. Dr. M. S. Sujatha, B.Lakshmi, " Simulation and analysis of FLC & FOFLC based MPPT and charge controller for PV system, International Journal of Condition Monitoring and Diagnostic Engineering Management, Vol.24 no. 2, PP.29-34.