

Design & Development of A Fire Alarm Circuit using IoT based Instrumentation Concepts used in Physics

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Abstract— Fire Alarm Circuit is a simple circuit that detects the fire and activates the Siren Sound or Buzzer. Fire Alarm Circuits are very important devices to detect fire in the right time and prevent any damage to people or property. Fire Alarm Circuits and Smoke Sensors are a part of the security systems which help in detecting or preventing damage. Installing Fire Alarm Systems and Smoke Sensors in commercial buildings like offices, movie theatres, shopping malls and other public places is compulsory. There are many expensive and sophisticated Fire Alarm Circuit in the form of stand-alone devices, but we have designed five very simple Fire Alarm Circuits using common components like Thermistor, LM358, Germanium Diode, LM341 and NE555. This is a very simple alarm circuit using Thermistor, LM358 Operational Amplifier and a Buzzer. The primary purpose of fire alarm system is to provide an early warning of fire so that people can be evacuated & immediate action can be taken to stop or eliminate of the fire effect as soon as possible Alarm can be triggered by using detectors or by manual call point (Remotely). The research paper explores the integration of Internet of Things (IoT) principles and instrumentation concepts from physics in the creation of an advanced fire alarm circuit. The study focuses on leveraging IoT technology to enhance fire detection capabilities through smart and wireless communication. The circuit's design incorporates physics-based instrumentation concepts to ensure accuracy and reliability in fire detection. The research aims to contribute to the development of innovative solutions in fire safety by combining modern IoT approaches with fundamental principles from the field of physics.

Index Terms— Fire Alarm Circuit, IoT (Internet of Things), Instrumentation Concepts, Physics, Design and Development, Sensor Technology, Smart Fire Detection, Wireless Communication, Remote Monitoring, Embedded Systems.

I. INTRODUCTION TO THE RESEARCH WORK

In our day-to-day life, we typically use several electronic appliances such as calling bell, TV remote, automatic outdoor lights, automatic door opening systems, fire alarm systems, etc. These electronic home appliances are designed using various electronics projects that include sensor based circuits, microcontroller based circuits, embedded circuits, communication based projects and so on. In this article, let us discuss about simple fire alarm circuit using thermistor. The most essential electronic device at home or industry or any other place where there is a chance of fire accident is a fire alarm circuit. The fire alarm circuit can be defined as an electronic circuit used

for identifying fire accident and alert. Thus, by using the fire alarm circuit, we can avoid financial loss and also save people from dangerous fire accidents [1][2].

Safety and health are two important parameters that humans should always take care of. These two things are necessary for doing any work anywhere, either workplace, or homes, or streets; safety matters. A safe workplace reduces injury and illness expenses, increases productivity and quality. To put it another way, safety is beneficial to the company. Safety comes with precautions. And that's why people are installing alarms on every level of industries, home, industries, etc. One of those alarms is the fire alarm, to immediately protect surroundings from fire. Thus, this article discusses the fire alarm circuit diagram. The Fig. 1 gives the concept of fire in the house / industry / work place [3][4].



Fig 1: Concept of fire in the house / industry / work place

II. OVERVIEW

The increasing integration of Internet of Things (IoT) technologies into various domains has paved the way for innovative solutions in safety and instrumentation. This research paper, titled "Design & Development of A Fire Alarm Circuit Using IoT based Instrumentation Concepts used in Physics," explores the intersection of physics-based instrumentation concepts and IoT to address fire safety concerns [5].

Fire alarm systems play a crucial role in early detection and response to fire incidents, significantly contributing to the safety of occupants and minimizing potential damages. In this context, the research focuses on the design and development of a fire alarm circuit, leveraging IoT-based instrumentation principles rooted in physics [6].

The integration of IoT adds a layer of intelligence and connectivity to traditional fire alarm systems. By incorporating physics-based instrumentation concepts, the research aims to enhance the precision and reliability of fire detection mechanisms. This paper delves into the theoretical foundations, design considerations, and practical implementation of the proposed fire alarm circuit, offering insights into how physics principles can be harnessed for improved fire safety [7].

The innovative approach explored in this research not only contributes to the advancement of fire safety technology but also showcases the potential synergies between IoT and physics-based instrumentation. As we delve into the details of the design and development process, the paper provides a valuable contribution to the broader discourse on enhancing safety systems through the integration of cutting-edge technologies [8].

III. PROBLEM STATEMENT

- In big cities, the problem is associated with the space and high installation cost of fire alarms. Therefore these are not affordable for middle class.
- So we have designed a fire alarm system that all people can use. It will detect the fire and alerts the residents.
- It requires a less installation space.

IV. OBJECTIVES

- The primary purpose of fire alarm system is to provide an early warning of fire so that people can be evacuated & immediate action can be taken to stop or eliminate of the fire effect as soon as possible.
- The objective of this work is to construct a device that will detect the fire by monitoring environmental changes associated with combustion.

V. PROPOSED METHODOLOGIES ADOPTED

Tools used (hardware / software) - Breadboard, 9v battery, Connecting wires, LM358 IC op-amp, Resistor (10k), Pot(10k), Buzzer, Thermistor (10k). The Fig. 2 gives the circuit used for fire alarm detection process. The Fig. 3 gives the circuit rig up in breadboard for fire detection using thermistors & the Fig. 4 gives the components used for the fabrication process. The Fig. 5 gives the fire alarm getting the sound [9][10].

- The fire alarm working principle is based on thermistor used in the fire alarm circuit.
- This fire alarm circuit is used to identify and indicate an increase in temperature beyond certain value (temperature of enclosed area).
- All Fire Alarm Systems essentially operate on the same principle. If a detector detects smoke or heat, or someone operates a break glass unit, then alarm sounders operate to warn others in the building that there may be a fire and to evacuate.
- A thermistor is an inexpensive and easily obtainable temperature sensitive resistor, thermistor working principle is its resistance depends upon the temperature.
- When temperature changes, the resistance of the thermistor changes in a predictable way. The benefits of using a thermistor are accuracy and stability

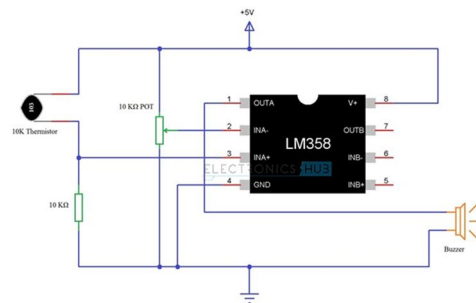


Fig. 2: Circuit used for fire alarm detection

VI. RESULTS & DISCUSSIONS

- It provides an early warning of fire so that people can be evacuated & immediate action can be taken to stop or eliminate the fire effect as soon as possible [11][12].
- A circuit is designed that will detect the fire by monitoring environmental changes associated with combustion [13][14].

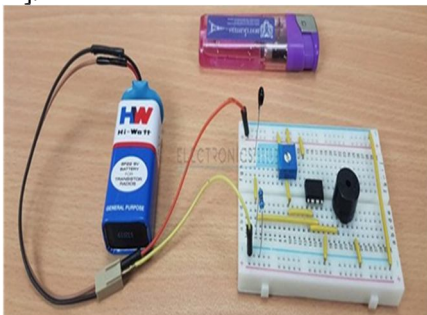


Fig. 3: Circuit rig up in breadboard for fire detection using thermistors



Fig. 4 : Components used for the fabrication process

VII. CONCLUSIONS

In conclusion, the research on the proposed topic presented in this research article underscores the potential of integrating IoT technologies with fundamental physics principles to advance fire safety measures. The developed fire alarm circuit demonstrates the feasibility of combining sophisticated instrumentation with real-time data analysis to achieve more accurate and responsive fire detection. By leveraging physics-based concepts, the circuit enhances the precision of sensing mechanisms, contributing to the early identification of fire incidents and, consequently, faster response times [19][20].

Furthermore, the findings of this research highlight the broader implications for the intersection of IoT and physics in safety applications. The successful implementation of the proposed circuit not only advances fire safety technology but also opens avenues for exploring similar synergies in other domains. The research serves as a stepping stone for future developments in intelligent safety systems, emphasizing the importance of interdisciplinary approaches that leverage both technological and scientific principles to enhance overall safety and security standards [17][18].

In conclusion, the research paper successfully demonstrates the integration of cutting-edge Internet of Things (IoT) technology with fundamental principles from physics to create an advanced fire alarm circuit. The study highlights the potential of IoT-based instrumentation in enhancing fire detection capabilities, offering a smart and wireless solution for improved safety. The developed circuit not only leverages modern technology but also incorporates foundational physics concepts to ensure precision and reliability in fire detection. The findings of this research contribute to the ongoing efforts in advancing fire safety systems, providing a valuable fusion of contemporary IoT methodologies and classical physics principles in the realm of fire alarm design and development [15][16].

- Hence electronic circuits can be designed for the fire based alarms and they provide very high efficiency and can be used for the security reasons. Early fire detection is best achieved by the installation and maintenance of fire detection equipment in all rooms and areas of the house or building [14].
- To overcome disadvantages and looking for implementation of automatic fire detection [13].
- In the place of thermistor, we can use sensors [12].
- Uses the speakers instead of a buzzer with warning messages and audio alert signals [11].



Fig. 5 : Fire alarm getting the sound

VIII. ADVANTAGES

- Sensing of fire(heat) easily
- Simple circuit
- Low power consumption
- Low cost

IX. APPLICATIONS

- Home security system
- School/college labs
- Industries
- R&D Cells

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