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PYRO ELECTRIC FIRE ALARM

Project Associates

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ABSTRACT

This project is an ultra-sensitive fire sensor that exploits the direct piezoelectric property of an ordinary piezo element to detect fire. The lead zircon ate titanate crystals in the piezo element have the property to deform and generate an electric potential when heated, thus converting the piezo element into a heat sensor. The circuit described here is very sensitive. It gives a warning alarm if the room temperature increases more than 10°C. The entire circuit has two sections—the sensor and the power supply section.

The front part of the circuit has a sensitive signal amplifier. It gives a high output when temperature near the piezo element increases. In normal condition, the sensitive signal amplifier gives a low output and the remaining circuitry is in a standby state.

If heat near the piezo persists, after one minute, and the buzzer starts beeping. If heat continues, after four minutes, the relay will be energized. The solenoid pump connected to the N/O (normally opened) contact of the relay starts spraying the fire-ceasing foam or water to the possible sites of fire.

Power supply section comprises a 0-18V, 1A step-down transformer with a standard full-wave rectifier formed by D1 through D4 and filter capacitor C1. A regulator is used to get fixed positive 12V. An optional battery backup can be provided if the mains supply is cut-off due to short-circuit and fire. A 12V, 4.5Ah rechargeable battery can be used for backup to give sufficient current to the solenoid pump.

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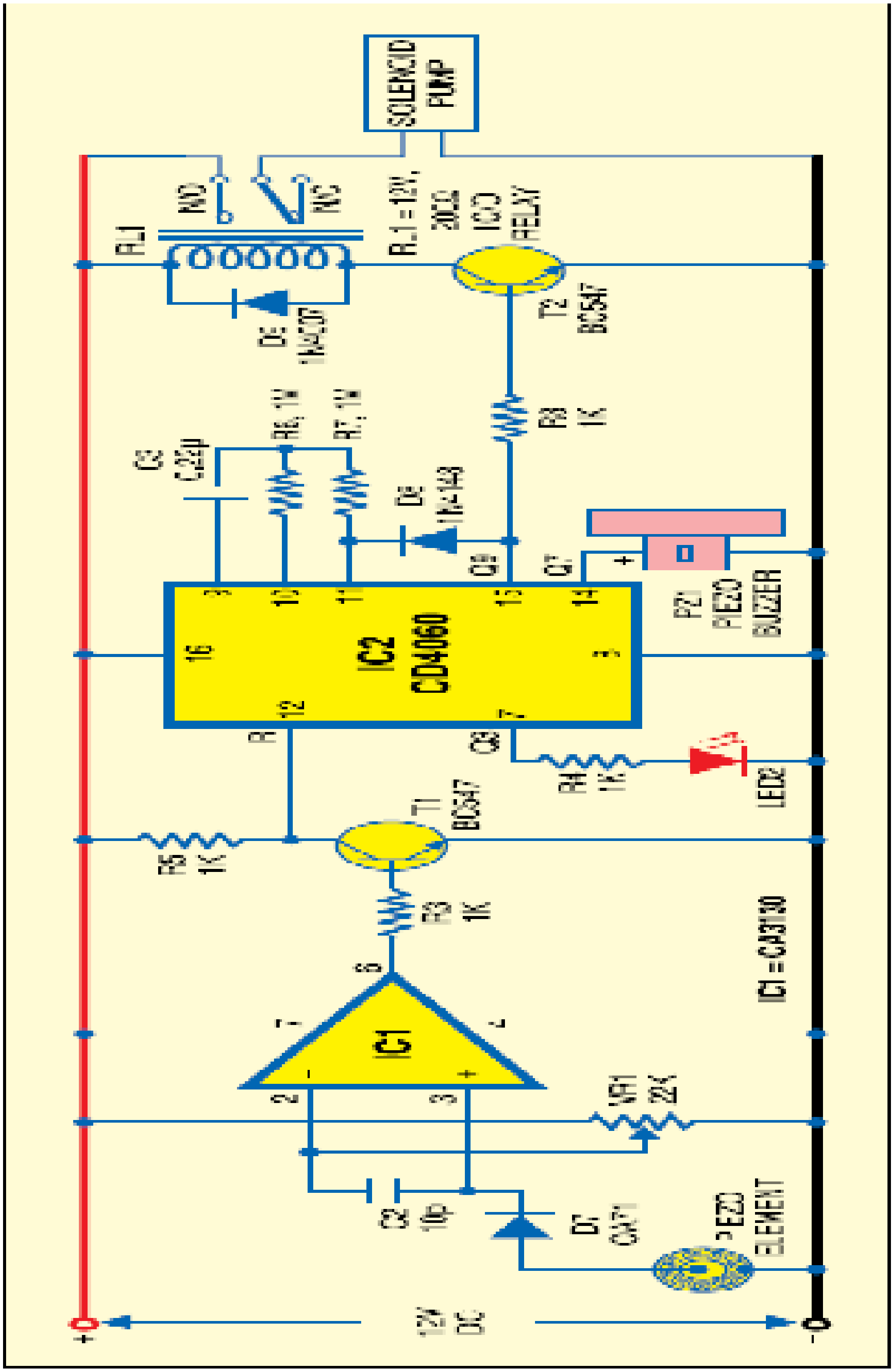
INTRODUCTION

In this busy world, minimizing the human effort and time is the ultimate aim of technology. An automatic fire alarm system is designed to detect the unwanted presence of fire by monitoring environmental changes associated with combustion. In general, a fire alarm system is classified as either automatically actuated, manually actuated, or both. Automatic fire alarm systems can be used to notify people to evacuate in the event of a fire or other emergency, to summon emergency services, and to prepare the structure and associated systems to control the spread of fire and smoke.

In simple words a fire alarm is used to detect the presence of fire. An automatic fire alarm is used to detect the unwanted presence of fire by monitoring environmental changes associated with combustion. Usually it is used to notify people to evacuate, to take necessary action in the event of a fire. The circuit described here is very sensitive. It gives a warning alarm if the room temperature increases more than 10°C. The entire circuit has two sections—the sensor and the power supply section. Wall or floor mounted solenoids or electromagnets controlled by a fire alarm system or detection component that magnetically secures spring-loaded self-closing smoke tight doors in the open position. Designed to de-magnetize to allow automatic closure of the door on command from the fire control or upon failure of the power source, interconnection or controlling element. Stored energy in the form of a spring or gravity can then close the door to restrict the passage of smoke from one space to another in an effort to maintain a tenable atmosphere on either side of the door during evacuation and firefighting efforts.

CIRCUIT DIAGRAM

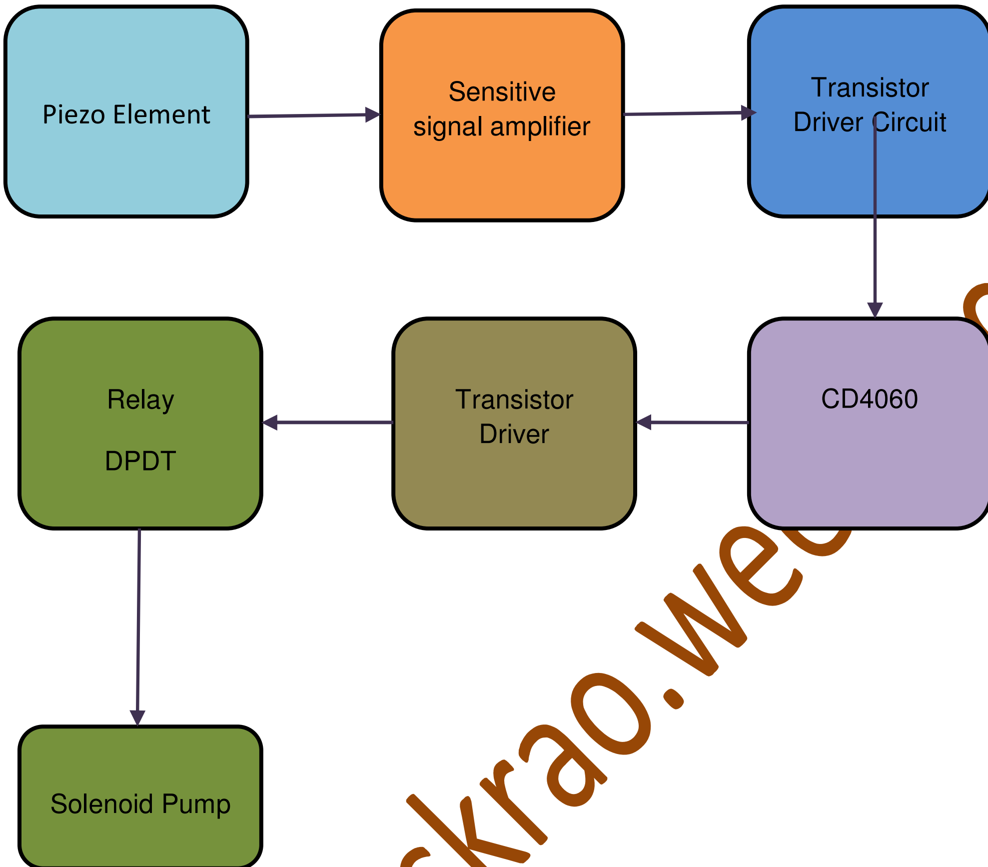


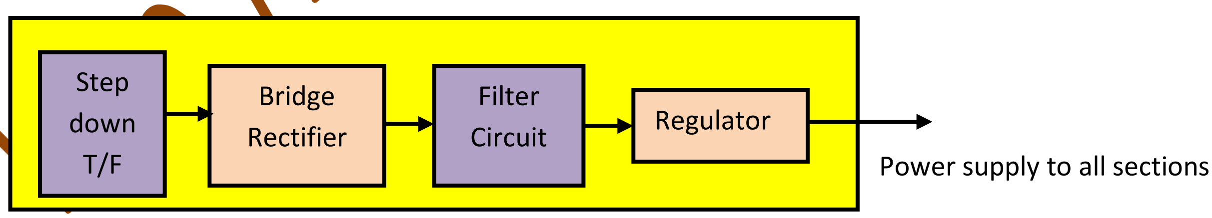
COMPONENTS LIST

The various components required for implementation of our circuit are listed as follows.

- Piezo element - 1 No.
- Diode [OA71] - 1 No.
- Capacitor[10pF] - 1 No.
- IC[CA3130] - 1 No.
- Resistors[1K Ω] - 4 No.s
- Transistor [BC547] - 2 No.s
- IC[CD4060] - 1 No.
- Resistors[1MΩ] - 2 No.s
- Capacitor[0.22µF] - 1 No.
- Diode [IN4007] - 1 No.
- Piezo buzzer - 1 No.
- Diode [IN4148] - 1 No.
- Relay[12v, 200Ω 1c/o] - 1 No.

BLOCK DIAGRAM

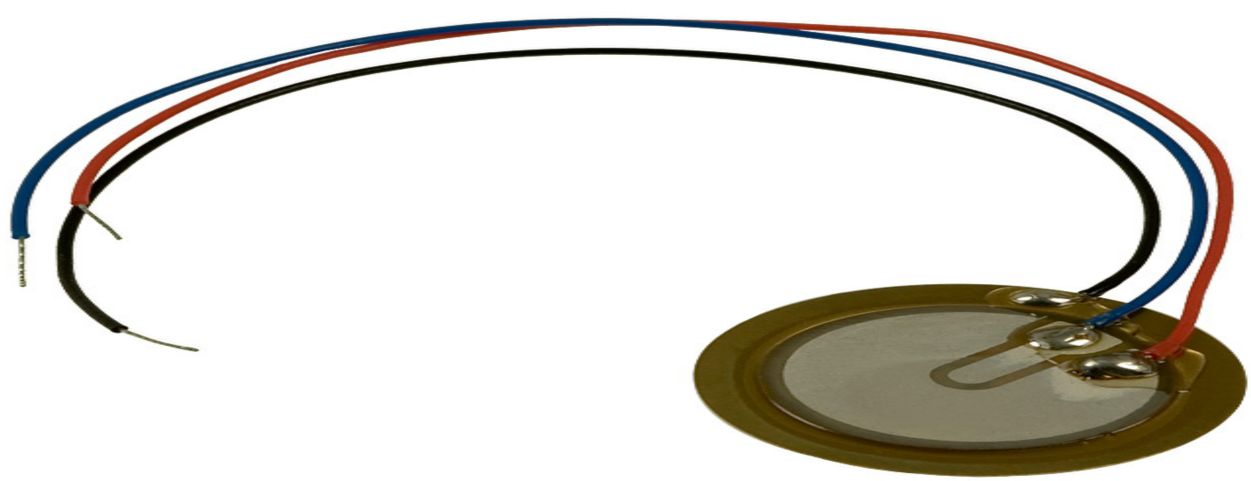




PIEZO ELEMENT / SENSOR

A piezoelectric sensor is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical signal. Piezoelectric sensors have proven to be versatile tools for the measurement of various processes. They are used for quality assurance, process control and for research and development in many different industries. Although the piezoelectric effect was discovered by Curie in 1880, it was only in the 1950s that the piezoelectric effect started to be used for industrial sensing applications. Since then, this measuring principle has been increasingly used and can be regarded as a mature technology with an outstanding inherent reliability. It has been successfully used in various applications, such as in medical, aerospace, nuclear instrumentation, and as a pressure sensor in the touch pads of mobile phones. In the automotive industry, piezoelectric elements are used to monitor combustion when developing internal combustion engines. The sensors are either directly mounted into additional holes into the cylinder head or the spark/glow plug is equipped with a built in miniature piezoelectric sensor.

The rise of piezoelectric technology is directly related to a set of inherent advantages. The high modulus of elasticity of many piezoelectric materials is comparable to that of many metals and goes up to 10e6 N/m^2[dubious – discuss]. Even though piezoelectric sensors are electromechanical systems that react to compression, the sensing elements show almost zero deflection.



This is the reason why piezoelectric sensors are so rugged, have an extremely high natural frequency and an excellent linearity over a wide amplitude range. Additionally, piezoelectric technology is insensitive to electromagnetic fields and radiation, enabling measurements under harsh conditions. Some materials used (especially gallium phosphate or tourmaline) have an extreme stability even at high temperature, enabling sensors to have a working range of up to 1000°C. Tourmaline shows pyro electricity in addition to the piezoelectric effect; this is the ability to generate an electrical signal when the temperature of the crystal changes. This effect is also common topiezoceramic materials.

Principle	Strain Sensitivity [V/μ*]	Threshold [μ*]	Span to threshold ratio
Piezoelectric	5.0	0.00001	100,000,000
Piezoresistive	0.0001	0.0001	2,500,000
Inductive	0.001	0.0005	2,000,000
Capacitive	0.005	0.0001	750,000

WORKING

The entire circuit has two sections the sensor and the power supply section. Sensor side circuit. The front end of the circuit has a sensitive signal amplifier built around IC1 (CA3130). It gives a high output when temperature near piezo element increases. ICCA3130 is a CMOS operational amplifier with gate protected p-channel MOSFETs in the inputs. It has high speed of performance and low input current requirements. There are two inputs the non-inverting input (pin 3) connected to the piezo element through diode D7 (OA71) that carries the voltage signal from the piezo element and the inverting input (pin 2) that gets a preset voltage through VR1. By adjusting VR1, it is easy to set the reference voltage level at pin 2. In normal condition, IC1 gives a low output and the remaining circuitry is in a standby state. Capacitor C2 keeps the non-inverting input of IC1 stable, so that even a slight change in voltage level in the inputs can change the output to high. Normally, IC1 gives a low output, keeping transistor T1 non-conducting. Resetting pin 12 of IC2 (CD4060) connected to the collector of transistor T1 gets a high voltage through R5 and IC2 remains disabled. When the piezo element gets heat from fire, asymmetry in its crystals causes a potential change, enabling capacitor C2 to discharge. It momentarily changes the voltage level at pin 3 of IC1 and its output swings high. Transistor T1 conducts taking the reset pin 12 of IC2 to ground. IC2 is now enabled and starts oscillating. With the shown values of the oscillating components C3 (0.22µ) and R6 (1M), the first output (Q3) turns high after a few seconds and a red LED2 starts flashing. If heat near the piezo persists, Q7 (pin 14) output of IC2 becomes high after one minute, and the alarm starts beeping. If heat continues, Q9 (pin 15) turns high after four minutes and turns on the relay driver transistor T2. At the same time, diode D8 conducts and IC2 stops oscillating and toggles.

The solenoid pump connected to the N/O (normally opened) contact of the relay starts spraying the fire-ceasing foam or water to the possible sites of fire.

CONCLUSION:

From pyro electric fire alarm we can get to the conclusion that piezo elements can sense heat not only pressure so we can further study the response of piezo element to wards heat.An ultra sensitive fire alaram can be prepared using a peizo sensor.

RESULT:

A pyro electric fire alarm is designed successfully.

APPLICATIONS:

- It can be used in industries, homes as fire alarms

- As a solenoid pump is included it can also be used as fire extinguisher by connecting a bucket of sand to solenoid pump.

FEATURES :

- Safety lights to provide illumination during an alarm.
- Silence buttons that will quiet the alarm for a few minutes at a time. Detectors with this feature are commonly placed in kitchens.
- Intercommunication of hardwired smoke detectors that guarantees if one alarm in the house goes off, they all go off. Even if the fire is detected in the basement, people upstairs will hear an alarm.

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