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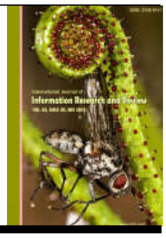

International Journal of Information Research and Review
Vol. 03, Issue, 05, pp. 2358-2361, May, 2016

Research Article

HIGH VOLTAGE FUSE BLOWN INDICATOR WITH VOICE BASED ANNOUNCEMENT SYSTEM

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ARTICLE INFO

Article History:

Received 19th February 2016
Received in revised form
31st March 2016
Accepted 16th April 2016
Published online 30th May 2016

Keywords:

Fuses,
Sensors,
IC,
Microcontroller.

ABSTRACT

High Voltage Fuse Blown Indicator with Voice Based Announcement System is a type of circuit used to alert the user in case of a fuse in any electrical equipment got fused. The technology used in the electrical equipment has developed to a very large extend. At the same time it gets necessary that the use of systems with automation and high security be used. This paper shows the study of fuses, the types of faults that occur in a system, and to detect whether a fuse has been blown out from the circuit with the help of power sensors, LEDs microcontrollers and based voice announcement using IC.

INTRODUCTION

Fuse are simple and cheap devices, despite their behavior being more complex than generally realized. They are used for the protection of electrical equipment. When any fault such as overcurrent or overvoltage, occurs it fuses out. Thereby, breaking the circuit and preventing the electrical appliances connected to be protected from fault.

High voltage fuse blown indicator with voice based announcement systems is to alert the user in case of a fuse in critical electrical equipment got fused. At times the user is unaware that the fuse has been fused out despite the voltage supply coming from the power station side and starts checking whether there is a problem in the device or the supply and does not check the fuse. Unlike circuit breakers, fuses are not resettable. Therefore, it is required to change the fuse every time it fuses out. For the convenience of the users so they may know when the fuse is blown out of the circuit high voltage fuse blown indicator with voice based announcement systems used.

Objective

The main objective of this project is

- Real-time monitoring of fuses
- Producing an alarm when the fuse is blown out
- Voice announcement according to the corresponding situations.

Fuses

Fuse is a low resistance resistor type of device which acts as a sacrificial device that provides overcurrent protection to a load or source circuit. A metal wire or strip is the most essential component that melts on the excess flow of current through the circuit, hence limiting the current from flowing in the circuit. Mismatched loads, overloading, short circuits, or device failure are the major reasons for over current. Fuses can be used instead of circuit breakers [https://en.wikipedia.org/wiki/Fuse_(electrical)]

The fuses are relatively small in size and are cost effective. Electric fuses incorporate current carrying elements, which depends on melting of these and their current ratings. When excessive overcurrents flow through them arcing occurs. They are designed to safely interrupt high fault currents that are encountered in service. Energy dissipated gets limited during fault periods, as the fuse operates rapidly in these circumstances. At present fuses are used at a very great number in many applications and their demand will be at a very high level in the coming years as well (Electric fuses, ?).

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History

Earlier in the 17^{th}-18^{th} century, when electricity was being developed for the basic utility the type of supply used was direct current. Cutting of alternative current is more easier than of direct current. So the development of fuses was necessary.
In 1864, in order to protect submarine cables fuses used were of the form of platinum wires as mentioned by W.H. Preece. Later on it was found that the use of fuse wires was inadequate and then a scientist named Professor S.P. Thomson invented an improved fuse. A metallic ball made of low melting alloy was connected in between two iron wires.

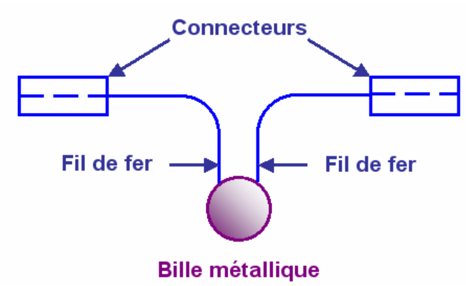

Fig.1. Fuse with alloy ball by Professor S.P. Thomson (1879)

In 1883 an improved model was suggested by H.H. Cunyngham and C.V. Boys in which two metallic wires were soldered to each other. When the maximum current was through the circuit the soldering would melt and the wires would move in opposite direction.

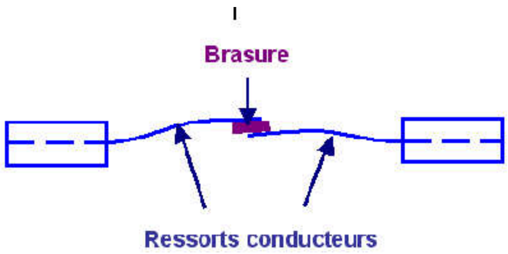

Fig. 2. Fuse by Cunyngham and Boys (1883)

In April 1881,Thomas Edison stated that fuse is a *safety guard* and can be used for over current protection. In 1890, W.M. Mordey invented the filling in fuses, i.e. the introduction of fuse wire in a glass vessel or similar vessel. The tube could be filled with sand, mica or asbestos which would extinguish the arc produced on the melting of the fuse wire.

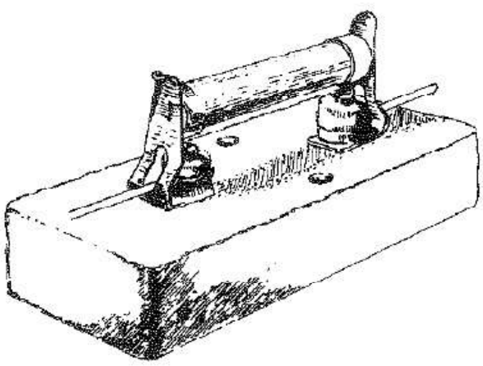

Fig. 3. Cartridge fuse by W.H. Mordey (1890)

Classification of fuses

Fuses are mostly classified as (1) Low Voltage Fuses and (2) High Voltage fuses.

Low voltage fuses

- Semi-enclosed rewireable fuse- Rewireable fuse is used in interrupting low fault current. It consists of a fuse carrier and a base. The base carries the fixed contact that is connected to the incoming and outgoing phase wires. The fuse carrier consists of the fuse element between the terminals. The fuse carrier can be taken out and placed to the base when desired. In faulty conditions, the fuse element melts and the current to the circuit is interrupted. The fuse element in the fuse carrier is replaced by a new one. Then the current in the circuit resumes.
- High rupturing capacity (H.R.C.) Cartridge fuse-High Rupturing Capacitive Fuse has high current capacity for the first 16seconds. It provides current multiple path and the fuse is divided with marble powder so that heat does not circulate.

High voltage fuses

- Cartridge type- It is similar to the low voltage cartridge type except there are some special features incorporated in the design. In some designs to avoid the corona effect at high voltage the fuse element is wound in the shape of helix. In some designs two fuse elements used which are placed parallel to each other: one element is of low resistance and the other of high resistance. In normal condition, the low resistance helps in the conduction of current. In faulty condition, the low resistance is blown out and the high resistance limits the short-circuit current and then breaks the circuit. They are used at 33kV with breaking capacity of 8700A.
- Liquid type- These fuses consist of carbon tetrachloride solution filled in a glass tube and sealed with brass caps at both ends. The fuse wire connected at one end of the tube and the other end is held by a strong phosphor bronze spiral spring at the other end of the tube. When over current flows the wire is blown out. When the fuse melts, the spring draws it into the liquid due to which fusion occurs in the liquid by this it extinguishes the arc.
- Metal clad fuses- This type of fuse is developed as a replacement for oil circuit breaker. They are used in high voltage circuits and operate well under short-circuit conditions.

Important terminologies

- Current rating- The current at which the fuse element operates without overheating or melting. It mostly depends on the temperature at the contacts of fuse holder and surroundings.
- Fusing current- The minimum current at which the element starts to melt and finally disconnected to protect the circuit. The relationship between fusing current I and diameter d of the element

$$I=kd^{3/2}$$

Where k is fuse constant

- Fusing factor-
- $Fusing\ Factor = \frac{minimum\ fusing\ current}{current\ rating\ of\ fuse}$
- Cut-off current- The maximum value attained by the fault current before the fuse starts to melt.
- Pre-arcing time- The time between the initiation of fault and the moment when cut off occurs.
- Arcing time- The time when the pre- archin time ends and when the arc is extinguished.
- Total operating time- The total of both arcing and pre-arcing time.

Reliability of fuses

Electric fuses are developed to not operate at normal load but to operate in emergency situations. Fuse starts to work when an increased heating is caused due to the flow of overcurrent. After some time at normal load the melting characteristic used earlier is not valid because of this two problems arise: guaranteeof quality and lifetime. Aging of fuses occurs mostly by elastic or plastic stress.

Stress is developed by imposing mechanical constraints at the end contacts or arc quenching. The fuse elements move after being subjected to thermal strain which contributes to the mechanical strain resulting to stress. This mechanical strain is classified into two; plastic strain and elastic strain. If the temperature is not very high and the duration of current pulses is short, the elastic strain is dominant. In the other case, plastic strain is dominant.

Blown Fuse Indicator

When a fuse blows out it can cause various problems such as Single Phasing conditions on the primary of a delta wye substation transformer which can lead to problems for electrical utilities and the consumers attached to them. During these conditions, sustained low voltages cause problems for single-phase and three-phase loads. Earlier studies were made in 2010, by the help of which LEDs and alarms were used in the indication of blown fuse in a circuit. When an equipment was placed in circuit and dictates no power, it may be due to a blown fuse. Hence first with the help of LEDs we check the condition of the fuse.

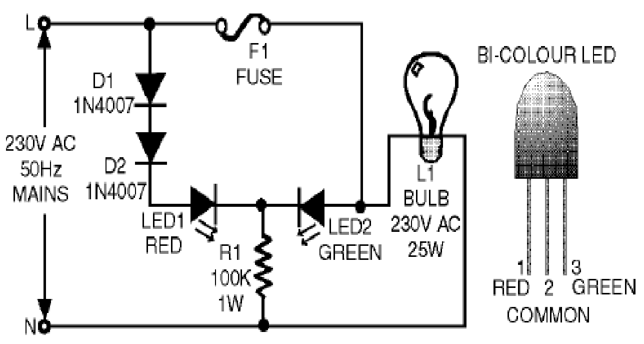

Fig. 4. Blown fuse indicator with LED

Under normal conditions, voltage drop in the first loop is 2V + (2 x 0.7V) = 3.4V, whereas in second loop it is only 2V. So current flows through the second loop, thus causing the green LED to glow, whereas the red LED is off. In the case of fuse blown out, the supply to green LED stops, and because only red LED is in the circuit, it glows. Both LEDs are off at the time of power failure [http://www.electronicsforu.com/EFYLinux/circuit/January2010/Blown%20Fuse%20Indicator.pdf] The circuit (in fig 1) can be modified by using alarms in the blown fuse condition. To trigger the alarm (in Fig 2) an opt coupler is used. As soon as, the red LED glows when the fuse blows out, simultaneously it turns 'on' the alarm. Similarly instead of using two diodes D1 and D2 only one diode can be used. These diodes are used to increase the voltage drop, since the two LEDs may produce different voltage drops [http://www.electronicsforu.com/EFYLinux/circuit/January2010/Blown%20Fuse%20Indicator.pdf]

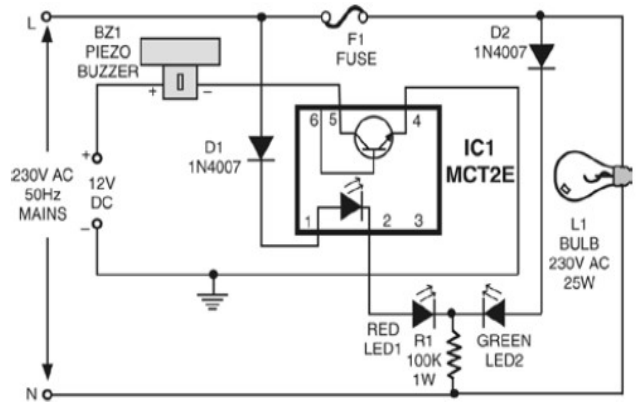

Fig. 5. Blown Fuse indicator with alarm

Basic Schematic of High Voltage Fuse Blown Indicator with Voice Based Announcement System

The high voltage fuse blown indicator with voice based announcement circuit is designed in a way that it consists of two power sensors. They are electrically isolated from each other and are used for sensing the electrical power in the circuit. The first power sensor is connected before the fuse to monitor the incoming voltage and the second is connected after the fuse. These sensors send the power status to the microcontroller. The microcontroller is programmed to keep a regular check on the power statuses of the two sensors. In normal condition, the power status of both the sensors will be equal. When there is a break in the fuse circuit, the microcontroller identifies that the power at the second sensor is low with respect to the first sensor and then gives the appropriate signal. When the power status at both the sensors is low, the microcontroller identifies it as a power supply failure and sends the appropriate signal. The signals are send to announce the appropriate message using an IC. The IC is stored with various messages and is played by operating it in playback mode. The IC is interfaced with the microcontroller carefully. The controller is programmed in such a way that the code inside it plays the appropriate message [www.mycollegeproject.com/Abstracts/SET-317.%20High%20voltage%20fuse%20blown%20indicatorHigh%20voltage%20fuse%20blown%20indicator%20with%20voice%20based%20announcement%20system.pdf]

Components

- Micro controller
- Regulated 5V/500mA Power supply

- 7805 three terminal voltage regulator
- 230/12V step down transformer
- LCD
- Relay
- Bulbs
- Current Sensor
- ADC
- Voice IC
- Speaker

Block diagram representation of the circuit

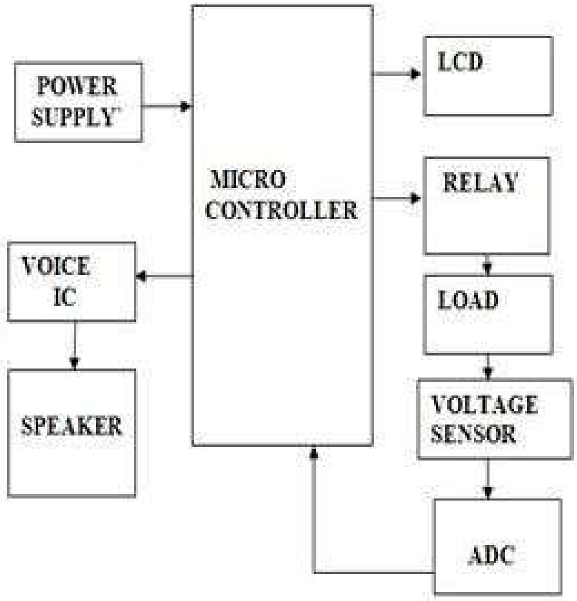

Fig. 6. Block diagram of High voltage Fuse Blown Indicator with Voice based announcement systems

Working

The main purpose in this project is to build a circuit which helps to indicate the user about high voltage and high current in the supply by using Voice based IC. The circuit is designed in such a manner that it gives a signal using Voice based IC when an overload occurs at the time of over-voltage and overcurrent fault. Technologies have developed to a very large extend. Hence, the requirement of automation in the systems has increased along with high electric security is preferred. At initial stage loads are indicated by using two bulbs. Current sensors are connected to the loads to sense the current consumed by them. ADC converts analog signal to digital signal. The converted data is fed to the microcontroller. Microcontroller is programmed by a simple C programming logic checks whether the current values are in its threshold level or not. If there is an increase in the current values the Microcontroller gives the signal to the Voice based IC which announces the desired correct voice message (http://www.slideshare.net/Ecwayt/high-voltage-fuse-blown-indicatorwith-voice-based-announcement-system-29910233).

Major Building Blocks

- Microcontroller based control system with regulated power supply.
- Two electrically isolated power status sensors.
- Microcontroller to PC interfacing circuit.
- Voice based IC.

Conclusion

The paper consists of a basic study of fuses, its classification important terminologies and its reliability in the protection of electrical equipment. It provides a basic study of how to indicate whether the electric fuse has been blown out of circuit using LEDs and alarm. The paper also presents the recent work on indication of fuse blown out with help of power sensors, microcontrollers and IC based voice announcement. The project provided an exposure to:

- Embedded C program.
- Electrical isolation between devices
- PCB designing
- Voice based IC characteristics
- IC interfacing
- Circuit design of voice based IC

This device has made it easier for the user to detect what sort of fault is present in the circuit and helps to prevent a fault at both user and supplier. It is helping the power supplier to detect the fault and preventing the power system to be harmed by it which would lead to damaging of many electrical appliances connected to the system.

REFERENCES

Electric fuses P.G. Newbery, B.Sc, C.Eng., M.I.E.E., and Prof. A. Wright, D.Sc, Ph.D., C.Eng., F.I.E.E.

http://www.electronicsforu.com/EFYLinux/circuit/January2010/Blown%20Fuse%20Indicator.pdf http:// www. slideshare.net/Ecwayt/high-voltage-fuse-blown-indicatorwith-voice-based-announcement-system-29910233

https://en.wikipedia.org/wiki/Fuse_(electrical)

Negative-Sequence Relay Protection for Blown High-Side Transformer Fuse Detection, Alan Hannah

Principles of Power System by V.K. Mehta

Reliability concept for electric fuses, X.Z. Meng, J.G.J.Sloot

TO THE ORIGINS OF FUSES, Jean-Louis GELET

www.mycollegeproject.com/Abstracts/SET-317.%20High%20voltage%20fuse%20blown%20indicator High%20voltage%20fuse%20blown%20indicator%20with %20voice%20based%20announcement%20system.pdf

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