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PROTECTIVE DEVICE WITH LIVE MONITORING OF ELECTRICAL APPLIANCE

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ABSTRACT- *The main aim of this innovative idea is to develop a protective method which may be considered as an alternative option to the protection device for the interruption of the circuit. To interrupt the current flow when the fault occurs up to the specified current limit in industrial and domestic sector since the supply of electricity to the consumers has been incorporated. There are different types of fuses available for distinct ratings since the requirement of electricity is various for non-identical consumers. As the people today have progressed so far towards modern innovative technology, there have been several developments in the protective devices. The recent progression in technologies have made operation of protective devices faster with quick response time and have adjustable setting which make them sustainable to vulnerable current. This protective device employs IOT (Internet of Things) based system having desirable setting with required rated current range selection unit and protective devices such as (relay and current sensor) for the purpose of flexible operation and this makes the currently opted method user friendly.*

***Key Words*: Protection Device, Fuse, Industrial and Domestic Sector, Modern Innovative Technology, IOT (Internet of Things), Relay and Current Sensor.**

1. INTRODUCTION

Reliable and efficient breaking of a circuit under various fault conditions is absolutely crucial for the protection of the healthy section of circuit to avoid any permanent harmful damaging or detrimental effects to the equipment being used.

In order to improve the existing protective system and to find standard solution of breaking the flow of current we have analysed the drawbacks and limitations offered by standard method of circuit breaking by taking into consideration the various aspects which are not currently in use and their absence limits the technological advancement.

The existing fuses and circuit breaking equipment lack inherent self-healing capability or any mechanism to implement circuit control or adjustable rating adaptiveness that is in-built in the device [1]. Thus, digitization and use of electronics at various required stages of circuit ensures that flexibility of the circuit is enhanced and we can have a modern approach to circuit breaking [2]. This method aims to include a wider range of control for the various conditions imposed in the current fault occurring circuit under consideration and the availability of different modes of operation to tackle specific fault conditions.

2. PROPOSED SYSTEM.

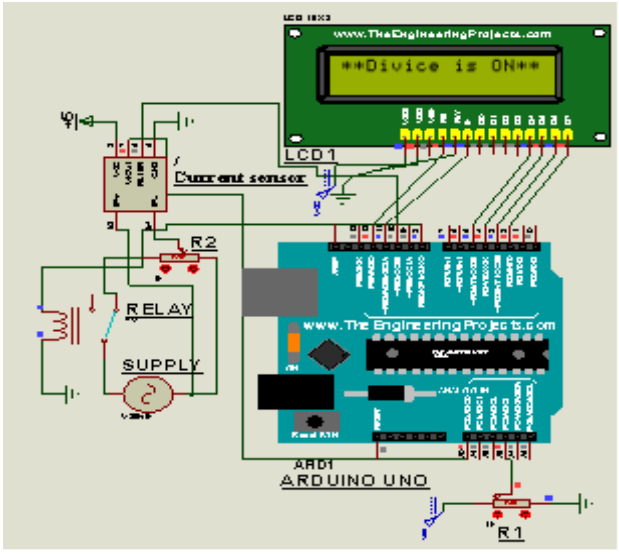


Fig. 1: Block diagram

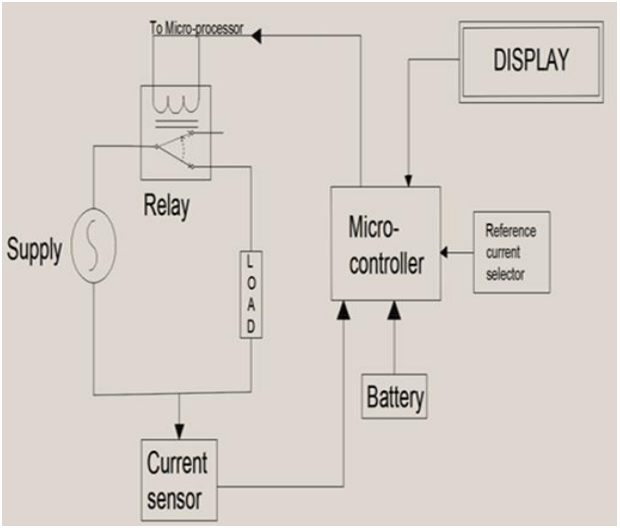


Fig. 2: Circuit diagram

The ac supply at our homes is usually 230 V. The AC supply provided to domestic users is usually about 230V / 440V depending on the requirement, the consumers of domestic electricity are continuously increasing and are never constant so the load varies every moment and hence also there will be fluctuation in the supply and this will cause damage to the system.

In order to avoid this, we have developed a method that can prove to be an ultimate solution for this cause. Arduino is programmed in such a way that the actual current and reference current is continuously monitored and both the currents are continuously compared. The actual current of the system is sensed by the current sensor and this value of current is converted to readable value which is suitable to micro-controller and is fed to the analog port of Arduino. While programming the micro-controller, reference current value is provided using a rated current range selector knob (R1), where as the value of reference current is set depending on the load (here R2) shown in fig.2.

During normal condition when the actual current value is less than the reference current value, the contacts of relay are in normally open position and the system operates normally. During the fault condition when the actual current reaches or exceeds the reference current value, this change in the actual current is sensed by the current sensor which is continuously monitoring the system. Once this change in the value of actual current is sensed the micro-controller detects it and as this rise in current value satisfies the condition mentioned in the program of the micro-controller, the relay controlled by the micro-controller is operated and the contacts of the relay are switched from normally close position to normally open position thus disconnecting the load from the supply and protecting the system from over current.

When the supply exceeds the specified limit, the relay operates and isolates the load from the circuit. Here, the output with all the remarks and current value is displayed on the LCD display; battery is used to power-up the micro-controller unit and other components of the protective device.

3. RESULTS

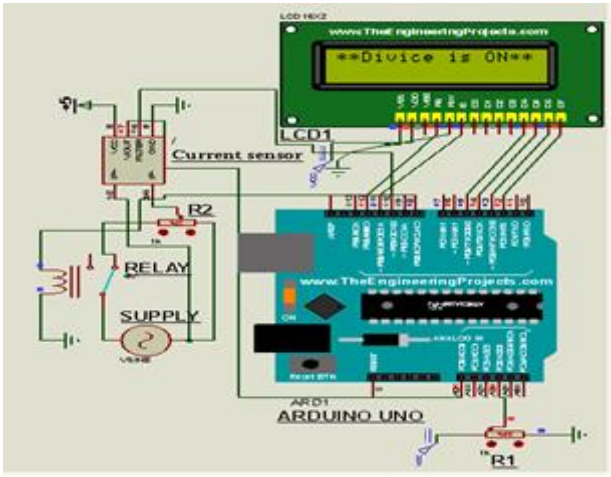


Fig.3: Proteus Software output 1, when the system is ON

3.1 Hardware Output:-

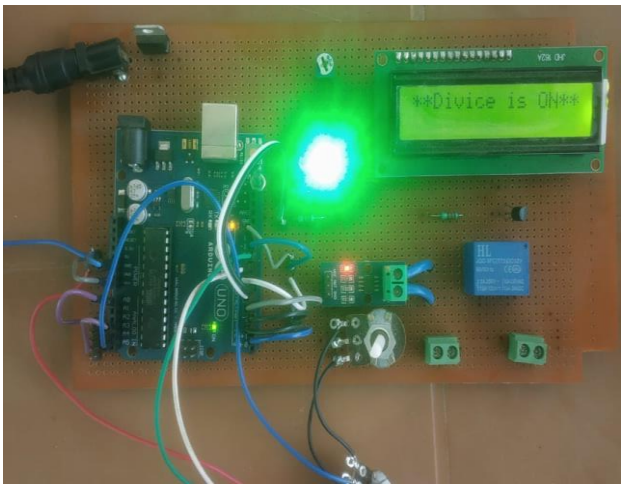


Fig.4: Hardware output device ON.

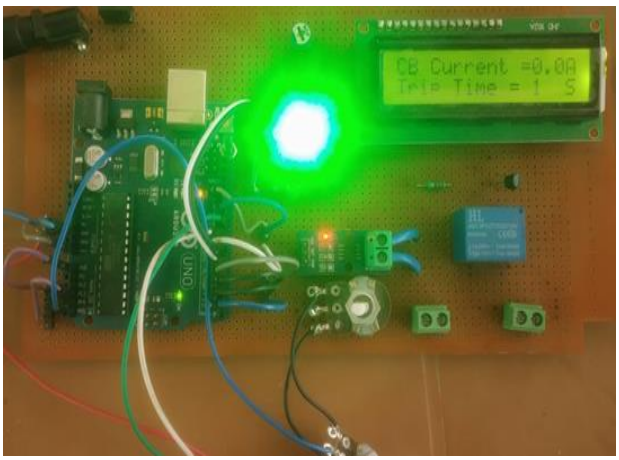
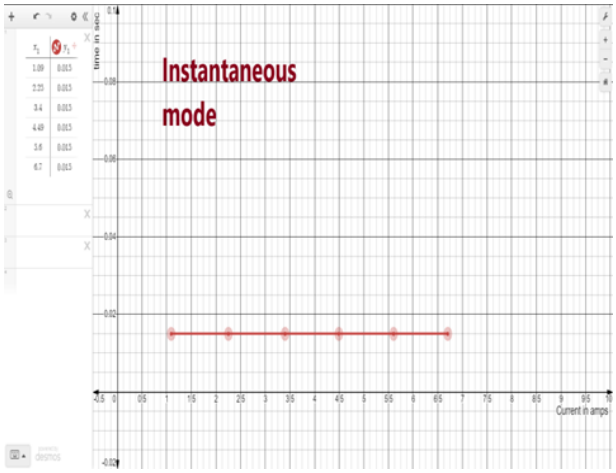


Fig.5: Proposed System operating.

3.2 Modes of operation

a. Instantaneous mode:

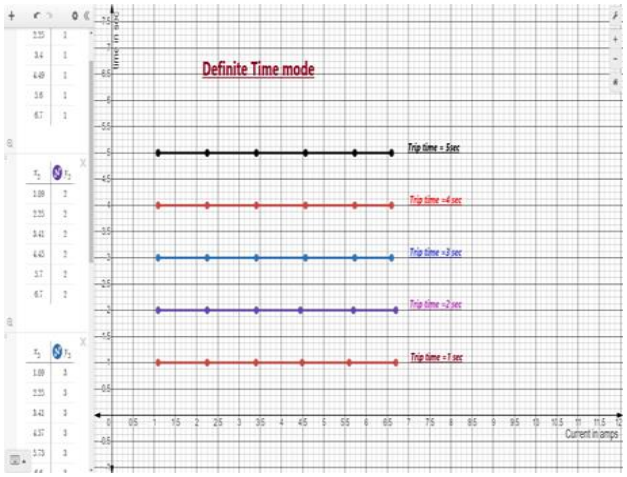
During the operation of instantaneous mode, overcurrent relay has no intentional time delay for operation. The contacts of the relay are closed instantly when the current inside the relay rises beyond the operational value. The time interval between the instant pick-up value and the closing contacts of the relay is very low. It has low operating time and starts operating instantly when the value of current is more than the relay setting. As shown in the below fig.6 we can clearly see that relay has instantly reacted to the actual current.



Graph.1 Instantaneous Mode of Operation.

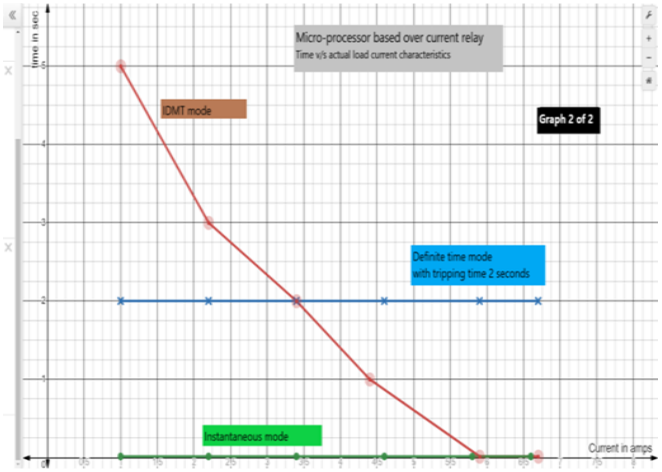
b. Definite time mode:

During the operation definite time mode, overcurrent operates after a definite period of time once the current exceeds the pickup value. Hence, this relay has current setting range as well as time setting range. Fig. 7 shows different tripping time (1seconds, 2seconds up to 5seconds) for various current values.



Graph.2 Definite Time Mode Operation.

c. IDMT mode:



Graph.3 IDMT Mode (Inverse Definite Minimum Time) results combined with instantaneous mode and definite time mode.

During the operation of IDMT mode, relay tripping time is inversely proportional to magnitude of fault current. As shown in the above fig. 8 it can be determined that the smaller the fault current value the greater the time and vice-versa.

3.3Comparison:-

S.NO.	PARAMETERS	EXISTING SYSTEM	PROPOSED SYSTEM
1	Tripping Time	About 1 second	5-15 milli seconds
2	Flexibility	Less flexible	More flexible
3	Replacement of the fuse after operation	1-2 times	Not required
4	Mode setting selection	Not available	Available (3 modes)
5	Handling of operation	Need to replace/rewire	Can be set to automatic or manual
6	Effect of environmental conditions	Yes	No
7	Maintenance	More	Less
8	Live monitoring	Not available	Available

Fig.9: Comparison of existing system and proposed system.

4. ADVANTAGES

- The proposed system uses micro-controller this makes the system to operate quickly and makes controlling easy.
- Modern relay has switching time of milli seconds, so the tripping of the relay during fault condition is faster.
- The proposed system allows use of IOT and so operator can easily monitor the present status of the device and the system.
- Operator has the provision to select one desired mode among IDMT, time constant and Instantaneous mode of operation.
- Proposed system is highly accurate, reliable and automated.
- The proposed system is precise to use fuse operation, future modification and maintenance in electrical system.
- Use of relay in the proposed system enables easy installation.
- The proposed system makes it easy to reset the device after relay being tripped.
- Since the proposed system uses relay as protecting device or isolating device, there is no need to rewire the fuse after the fault occurs.
- The proposed system senses and reads current in the circuit continuously thus the proposed system is error less.

4.1 DISADVANTAGES

- If there is some malfunction in the micro-controller, the system may misbehave. But chances of occurrence of such misbehave is almost nil.
- The proposed system can still be modified to higher level of operation by advancement in present technology.

5. CONCLUSION

The reusable protective device with live monitoring of electrical appliances is having advantages over conventional fuse as it provides several features like quick operation, live and continuous monitoring, automatic resetting, IOT platform, desired mode selection, future modification and scope, precise operation and makes the system suitable for any user. The proposed system uses modern relay having less switching time so during occurrence of fault the fast switching of the relay helps to isolate the load from the supply quickly and also the continuous current reading ability of the proposed system contributes in automatic operation of resetting of the device, presence of relay helps in saving time as process of rewiring conventional fuse or replacing the fuse cartridge after fault occurrence is not required. The existence of IOT platform in the proposed system makes the user to operate the system easily from remote places. The user can select particular mode from the available modes of operation and also, we can improve the protection scenario in the electrical appliances.

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