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Smart Ultra Fast Switching Circuit Breaker Using TRIAC BT136

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ABSTRACT: This paper is intended to fast protection of electric circuit from over load and a short circuit fault which is happens into the power system. So The smart ultra fast electronic circuit breaker is designed to work as an over current protection device. Conventional circuit breakers like miniature circuit breaker or a fuse is good at breaking the circuit when a short circuit fault occurs. But when an overload fault occurs, the tripping time is slow and depends on the percentage of overload. However, for sensitive loads it is very important to activate the tripping mechanism at the shortest possible time, preferably instantaneously. This project senses the current passing through a series element and the corresponding voltage drop is rectified to dc. This voltage is converted into a digital value and compared against a preset value by a microcontroller to generate an output that drives a triac to trip the load.

KEYWORDS: Electronic circuit breakers; Fast tripping time; TRIAC

I. INTRODUCTION

The **"Ultra-Fast Acting Electronic Circuit Breaker"** using PIC16F73 microcontroller is an exclusive project which is used to activate the tripping mechanism at the shortest possible time, preferably instantaneously

The smart ultra fast electronic circuit breaker is designed to work as an over current protection device. Conventional circuit breakers like miniature circuit breaker or a fuse is good at breaking the circuit when a short circuit fault occurs. But when an overload fault occurs, the tripping time is slow and depends on the percentage of overload. However, for sensitive loads it is very important to activate the tripping mechanism at the shortest possible time, preferably instantaneously. This project senses the current passing through a series element and the corresponding voltage drop is rectified to dc. This voltage is converted into a digital value and compared against a preset value by a microcontroller to generate an output that drives a triac to trip the load.

The unit is extremely fast and overcomes the drawback of the conventional circuit breakers. It uses a PIC Microcontroller.

A microcontroller is one of the main components used here. The current transformer acts as the sensor. The LCD displays the current status of the breaker. The current transformer senses the current passing through the main circuit and steps it down to a smaller value. The current in the main circuit can be sensed by taking the voltage drop across a resistor or by using a Potential Divider. But the current transformer is preferred as it is easy to use, avoids unnecessary energy losses and provides isolation. The current transformer will take the current in the main circuit and step it down to a very small value. This current is converted into voltage by passing it over a series resistor. This voltage is rectified and filtered and then given to the microcontroller. When current increases behind the certain limit then we are going to trip the load by using triac.

II. LITERATURE SURVEY

A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and interrupt current flow. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Conventional circuit breakers like miniature circuit breaker or a fuse is good at breaking the circuit when a short circuit fault occurs. But when an overload fault occurs, the tripping time is slow and depends on the percentage of overload. However, for sensitive loads it is very important to activate the tripping mechanism at the shortest possible time, preferably instantaneously.

Existing system:

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Conventional circuit breakers like miniature circuit breaker or a fuse is good at breaking the circuit when a short circuit fault occurs. But when an overload fault occurs, the tripping time is slow and depends on the percentage of overload. However, for sensitive loads it is very important to activate the tripping mechanism at the shortest possible time, preferably instantaneously.

Disadvantages of existing system:

- Slow tripping.
- Aging and wear.
- Vulnerability to heat.
- Can not protect against earth faults.

Proposed System:

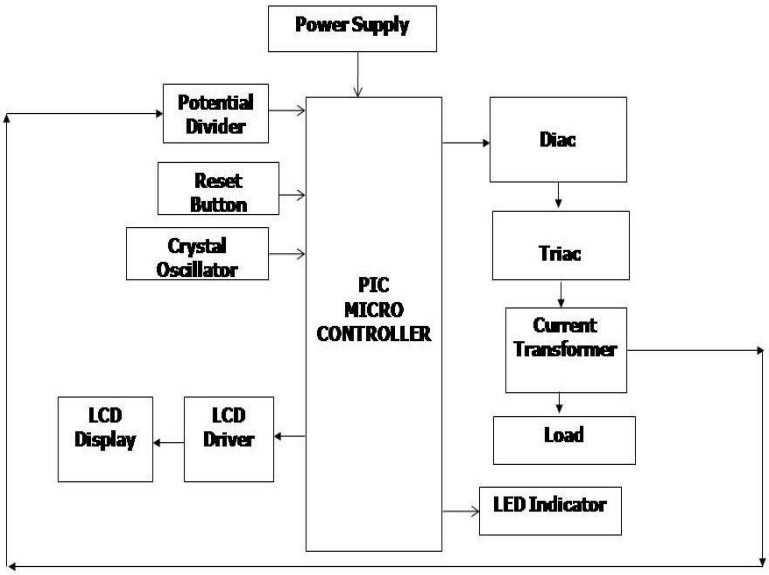
This proposed system provides a solution, This project senses the current passing through a series element and the corresponding voltage drop is rectified to dc. This voltage is converted into a digital value and compared against a preset value by a microcontroller to generate an output that drives a triac to trip the load. The unit is extremely fast and overcomes the drawback of the conventional circuit breakers.

III. METHODOLOGY

The main blocks of this project are:

1. Power Supply.
2. Microcontroller .
3. Current Transformer.
4. Crystal oscillator.
5. Reset.
6. LED indicators.
7. LCD with driver.
8. Triac&diac.
9. Potential Divider

Block Diagram



Circuit Diagram

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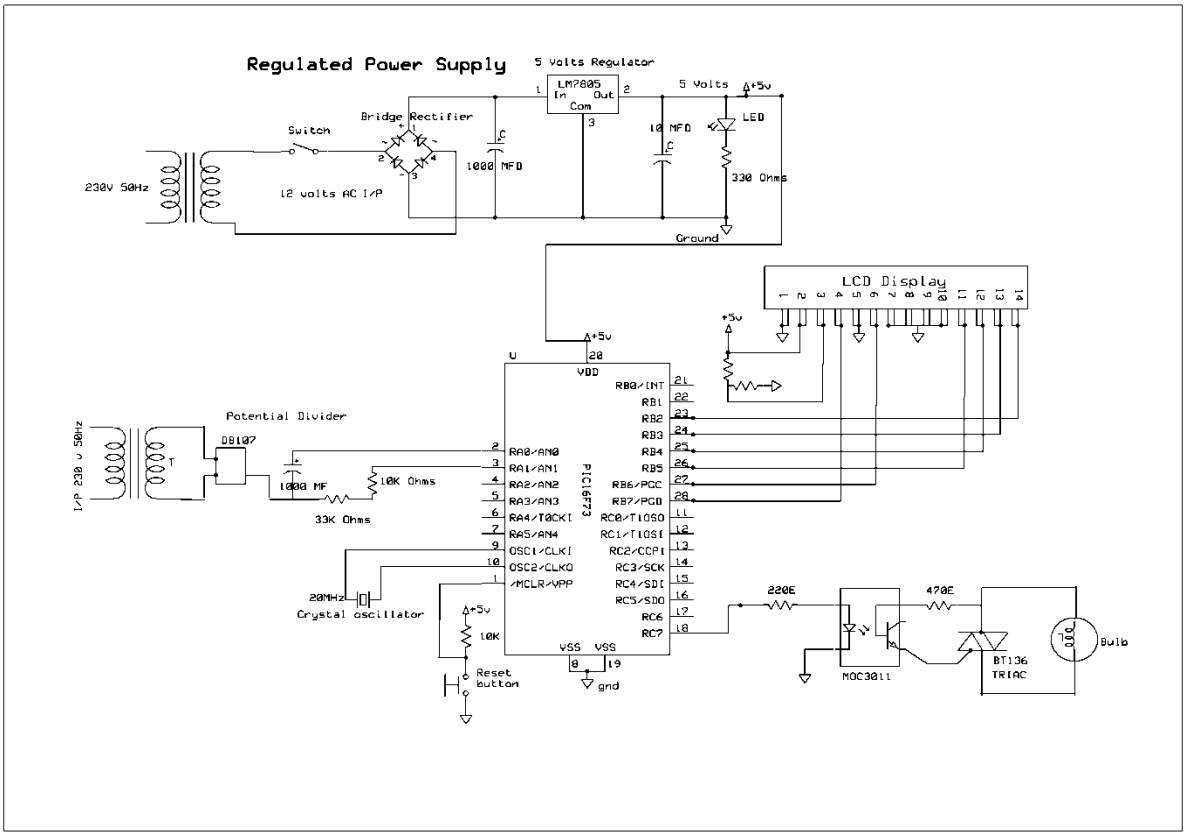

An Ultra-Fast Acting Electronic Circuit Breaker using a potentiometer, triac, and diac can be designed as follows:

• Potentiometer: The potentiometer is used to set the threshold current at which the circuit breaker should trip. It acts as a variable resistor to adjust the sensitivity of the circuit.

• Triac: The triac is a semiconductor device that acts as the main switching element in the circuit. It can conduct current in both directions and is triggered into conduction by a small gate current.

• Diac: The diac is a bidirectional trigger diode that is used to trigger the triac into conduction when the threshold current is reached. The diac breaks down at a certain voltage (breakover voltage) and allows current to flow through it, triggering the triac.

• Sensing Circuit: The sensing circuit monitors the current flowing through the circuit and compares it to the set threshold current. This circuit typically includes a current transformer to sense the current.

• Control Circuit: The control circuit processes the signal from the sensing circuit and generates a trigger signal for the triac when the threshold current is exceeded. This circuit may include amplifiers, comparators, and other components to provide the necessary control signals.

• Interruption Process: When the triac is triggered into conduction by the diac, it effectively shorts the circuit, rapidly interrupting the flow of current. This action protects the circuit from overcurrent conditions.

• Reset: After the fault condition is cleared, the circuit breaker can be reset by turning off the power to the circuit briefly, allowing the triac to reset. This type of circuit breaker offers fast and reliable protection against overcurrent conditions, making it suitable for applications where quick response times are critical.

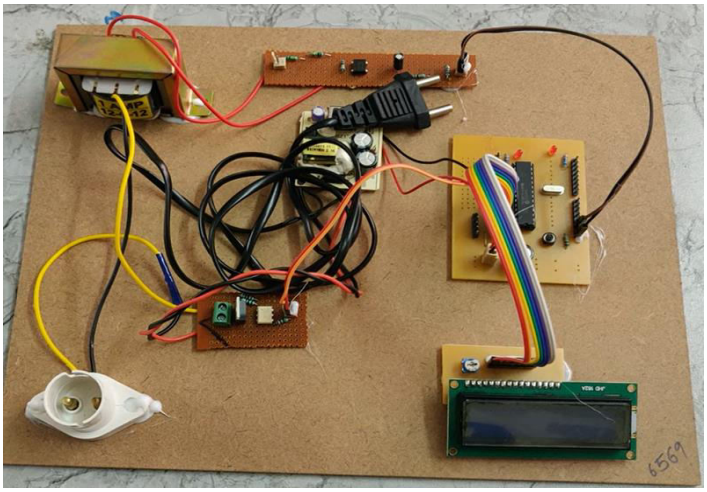

Fig-1 Prototype of Proposed System

IV. EXPERIMENTAL RESULTS

The project "**Ultra Fast Acting Electronic Circuit Breaker**" is designed to work as an over current protection device. Conventional circuit breakers like miniature circuit breaker or a fuse is good at breaking the circuit when a short circuit fault occurs. But when an overload fault occurs, the tripping time is slow and depends on the percentage of overload. However, for sensitive loads it is very important to activate the tripping mechanism at the shortest possible time, preferably instantaneously.

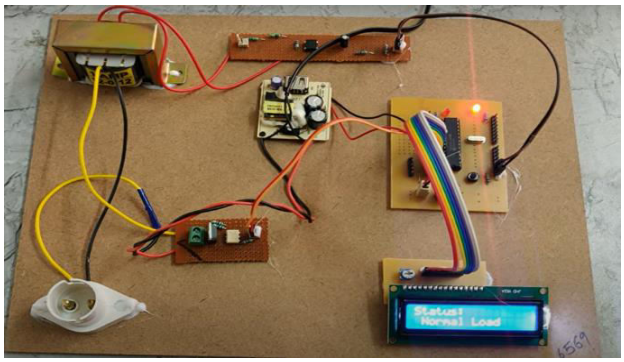

Fig-2 When Kit is ON and Supply is Given

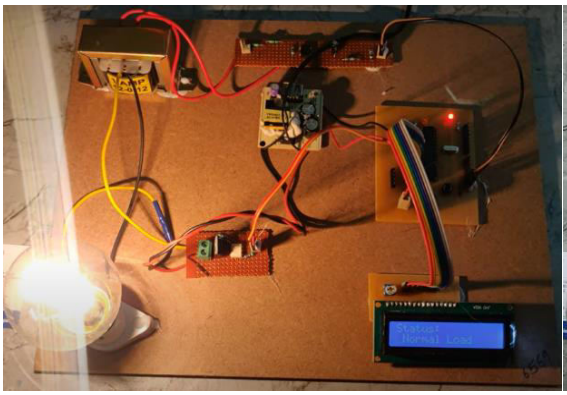

Fig-3 Under Normal Load 60W

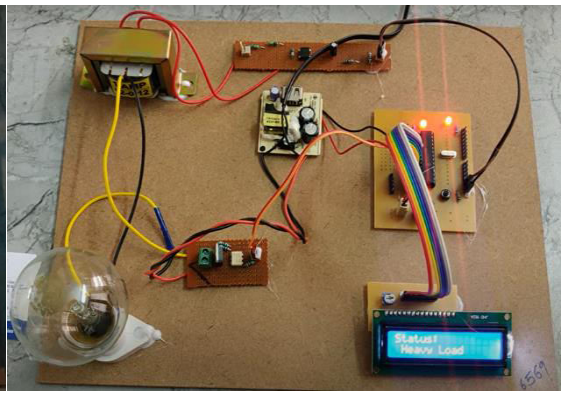

Fig-4 Under Heavy Load 100W

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V. CONCLUSION

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

VI. FUTURE SCOPE

For high voltage applications, the TRIAC could be replaced with an IGBT to eliminate the problem of arc extinction. Thus, by using an IGBT instead of a relay, the system can be used for over-current protection in both low voltage applications as well as high voltage application. Furthermore, the GSM module can be used to connect the circuit breaker to the internet for online monitoring and control

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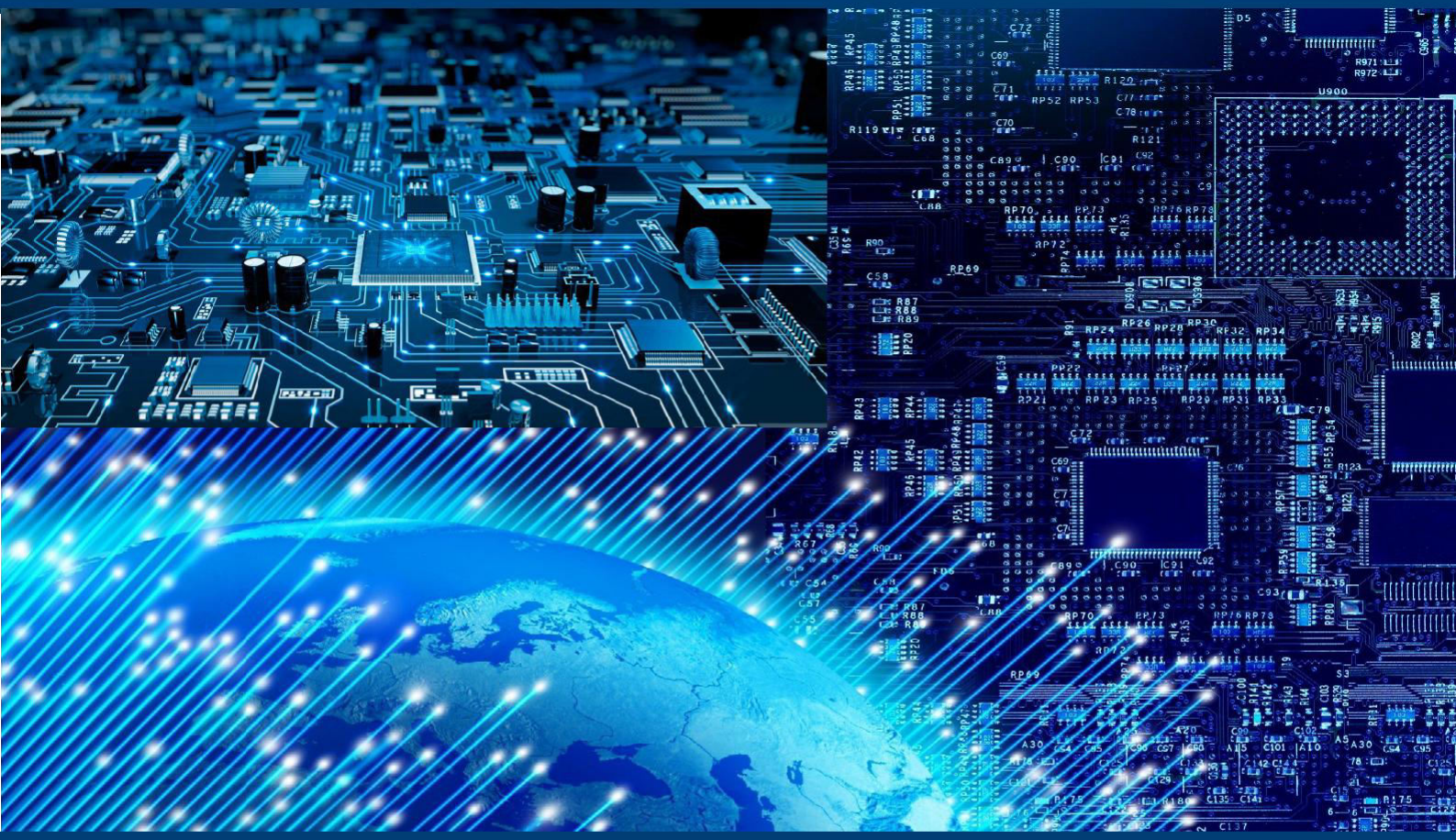

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