Simple over current protection system using Acs712 Current sensor

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***Abstract*— In this project simple over current protection system using Acs712 current sensor, Arduino Uno, switching relay, LCD display was developed through proteus simulation software. The system was developed for a simple DC circuit which provides a few controls to the users. The operating quantity in this project is the value of load current. By finishing this project, one may get some idea about the protection scheme using the Acs712 current sensor.**

***Keywords*— Acs712 current sensor, Arduino uno, Switching relay, NPN transistor**.

I. INTRODUCTION

In all kinds of electrical and electronic circuits, there must be some protection to protect the circuit from damage during the faulty condition. Depending upon the type of fault, the protection scheme varies. There are several types of protection schemes available like overcurrent protection, over-voltage protection, under-voltage protection etc. Among these methods' overcurrent method is the popular one. There are several ways for providing overcurrent protection. In this project combination of Acs712 current sensor, Arduino Uno and simple switching relay were used for achieving overcurrent protection. Here current sensor used for the means of sensing the value of current. Arduino Uno acts as a controlling device for the whole system. The relays provide the circuit breaking operation during the flow of over current. In this project there is some user control. Users can set priorities among the load which remains operative after the fault is cleared using a simple switch.

II. ACS712 CURRENT SENSOR

The ACS712 is a fully integrated, hall effect-based linear current sensor with 2.1kVRMS voltage isolation and an integrated low-resistance current conductor. Technical terms aside, it's simply put forth as a current sensor that uses its conductor to calculate and measure the amount of current applied. It works on 80kHz bandwidth. It has 66 to 185 mV/A output sensitivity. Device bandwidth is set via the new FILTER pin. Its Acs712 current sensor has 1.2 mΩ internal conductor resistance and a total output error of 1.5% at TA = 25°C. It has also stable output offset voltage and near-zero magnetic hysteresis. Its working principle is simple. When Current flows through the onboard hall sensor circuit in its IC the hall effect sensor detects the incoming current through its magnetic field generation. Once detected, the hall effect sensor generates a voltage proportional to its magnetic field that's then used to measure the amount of current [1]. The device has 3 pins, VCC, OUT, GND as shown in the Fig 1 [2].

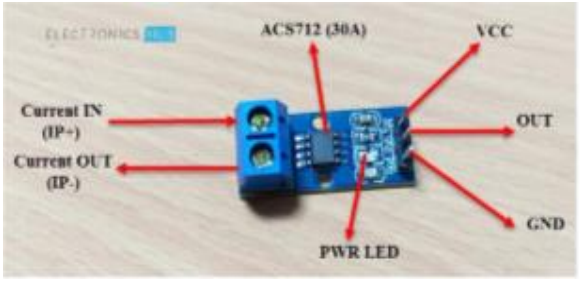

Fig. 1: Acs712 current sensor

III. ARDUINO UNO

An Arduino is a single-board microcontroller and a software suite for programming it to been embedded system. The hardware consists of simple open hardware design for the controller with an Atmel AVR processor and on-board I/O support. The software consists of a standard programming language and the boot loader that runs on the board. In other words, an Arduino is a tiny computer that one can program to process inputs and outputs between the device and external components connected to it. The Arduino UNO is a completed microcontroller board based on the ATmega328 microcontroller. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs light on a sensor, a finger on a button, or a Twitter message and turn it into an output activating a motor, turning on an LED, publishing something online. by sending a set of instructions to the microcontroller on the board can make the microcontroller to doing the required work. The Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. The figure. 2 illustrates the Arduino UNO microcontroller [3].

Fig. 2: Arduino UNO Microcontroller.

Table (1) describe the specifications of Arduino UNO [4].

Arduino UNO Microcontroller	Description
Rated operating voltage	5v
Recommended input voltage level	7v to 12v
Input/output digital pins	14
Analog input pins	8
DC current per the I/O pin	40 mA
DC current of 3.3v pin	50 mA
Flash memory	32 KB of which 0.5KB
SRAM	2KB
EEPROM	1KB
Clock speed	16000KHZ

IV. SWITCHING RELAY

Relay is an electro-mechanically operated switch, however, other operating principles are also used in relays, such as solidstate relays. A Relay is generally used when it is required to control a circuit by a separate low-power signal, or when several circuits must be controlled by one signal. They are classified into many types, a standard and generally used relay are made up of electromagnets which in general used as a switch. Dictionary says that relay means the act of passing something from one thing to another, the same meaning can be applied to this device because the signal received from one side of the device controls the switching operation on the other side. So, the relay is a switch that controls (open and close) circuits electro-mechanically. The main operation of this device is to make or break contact with the help of a signal without any human involvement in order to switch it ON or OFF. It is mainly used to control a high-powered circuit using a low power signal. Generally, a DC signal is used to control circuit which is driven by high voltage like controlling AC home appliances with DC signals from microcontrollers. Normally there are 5 pins. Normally open, normally closed, common, Coil 1 and Coil 2 as shown in Fig. 3 [5].

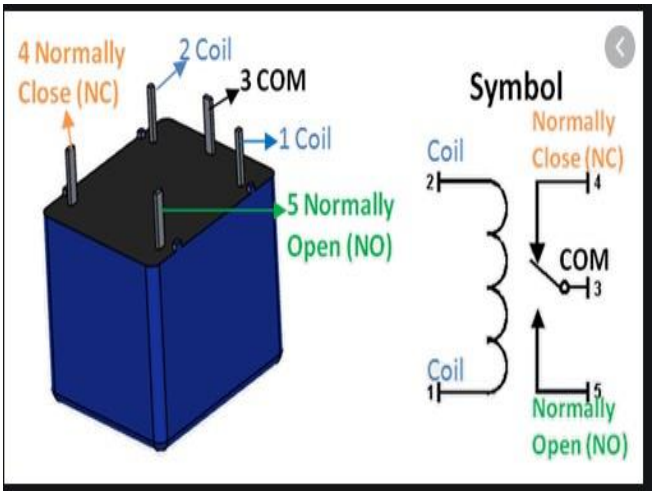

Fig. 3: Switching relay

V. WORKING PRINCIPLE

In this circuit, there were total of three loads, load A, load B and load C. Each load was connected with the corresponding relay as shown in the figure 4. The system was designed in such a way that when any one or two loads is on, the normal current would flow through the circuit. If all three loads on at a time then overcurrent would flow and if this current flows for 3sec then the load C would automatically disconnect from the circuit and load A, B would remain on after the fault has been cleared. Here the value of current was sensed by the current sensor which send this data to Arduino through analog pin A0.

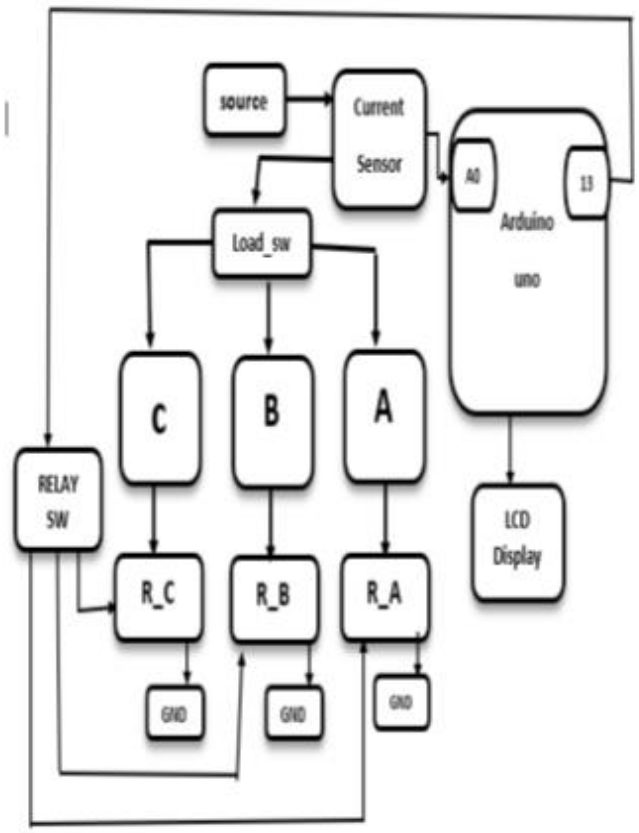

Fig. 4: Block diagram of the system.

Arduino convert this data into equivalent current and compare the value with the preset value of current to detect fault. Here when load A was turned on through load switch, corresponding current was 3.00 Amp. When both load A and B was turned on, corresponding current was 5.89 Amp. When all three loads were on, the value of current was 8.85 Amp. So, a preset value of current was set to detect the fault which was 5.99Amp. So, when all three loads were on, the value of current was 8.85 Amp which was greater than 5.99 Amp. In this case, digital pin 13 of Arduino uno would HIGH. This high value was received by the relay switch. The other end of relay switch was connected to the base of the NPN transistor which related to each of three relays. Since only load C need to disconnect during fault, this high value was passed through the relay switch to the base of NPN transistor which connected to the relay C. During fault this high value turned on the transistor which complete the relay circuit C. Hence relay C would operate and disconnect the load C from the circuit. When load C turned off, again value of current would be 5.89 Amp this is less than 5.99. So, these two loads would remain operative. Here using the relay switch one can select which load should turn off during fault and which should remain on.

VI. SIMULATION AND RESULT

1. Fig. 5: shows the complete simulated circuit on proteus.

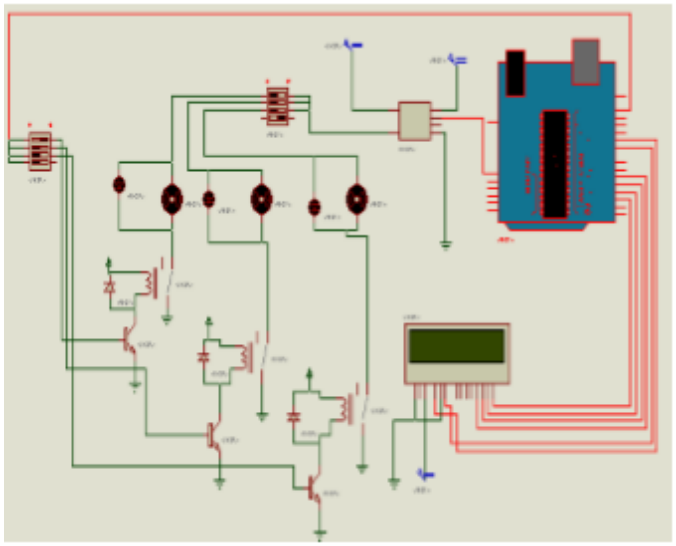

Fig. 5: complete simulated circuit on proteus.

2. Fig 6 shows the value of current when only load A was ON which was 3Amp. This was normal value of current.

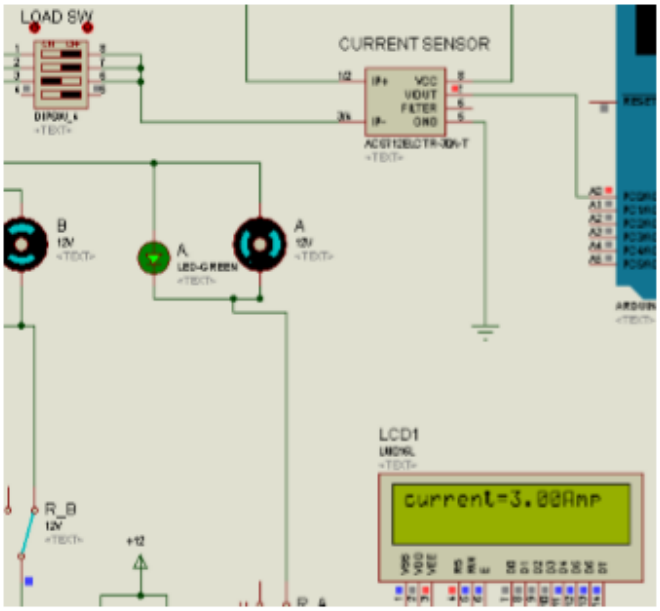

Fig. 6: Only load A is ON

3. Fig 7 shows the value of current when load A and B both were ON, and the value was 5.59Amp. This was normal value of current and less than the offset value which was 5.99 Amp

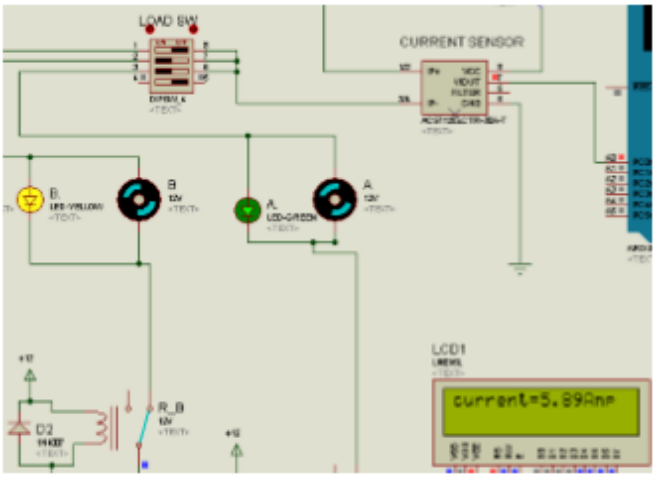

Fig. 7: Both load A and B is ON

4. Fig. 8: shows the value of current when all three load A, B and C were ON, and the value was 8.85Amp. The value was greater than 5.99 Amp which was offset value. So, this time overcurrent was flowing through the circuit.

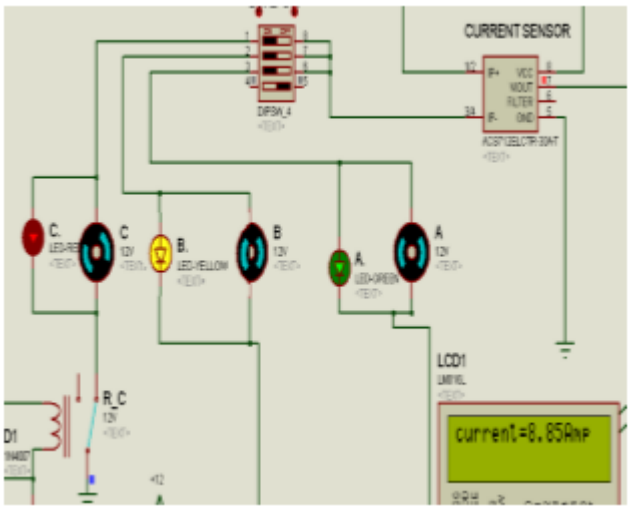

Fig. 8: Three loads ON at a time

5. Fault current flows for more than 3 sec. So, after 3 sec pin 13 of Arduino became high. This high value turned ON the NPN transistor connected to relay C. So, relay C became active and disconnected load C from the circuit which is shown in figure 9.

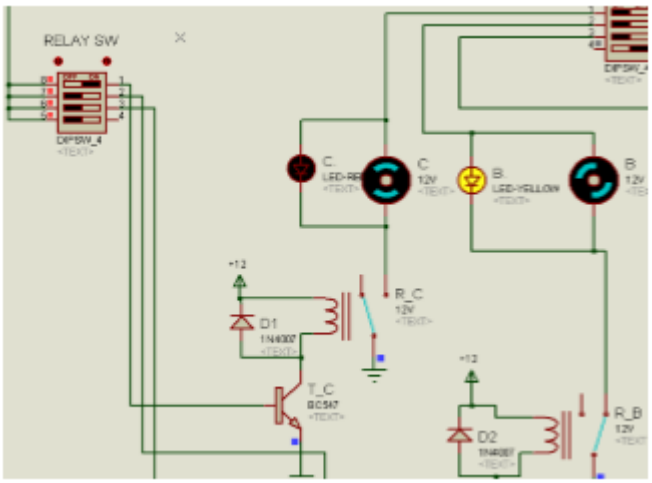

Fig. 9: Operation of relay C.

SUSTAINABILITY

The successful implementation of this project with current sensor, Arduino and switching relay will motivate continued exploration. The future works will include-

i. Designing this project in a larger scale with maximum amount of load.
ii. Implementation of this project for any real-life cases scenario (Power Station, Heavily populated areas)

CONCLUSION

The idea of the project was to detect the flow of overcurrent in the DC circuit and then according to requirement turned off specific load to prevent the overcurrent flow. The project was developed in proteus simulation software. There was no hardware implementation because of the current Coronavirus pandemic. But the simulated circuit worked properly. The operation of all relays was perfect. In this project when all three loads turned on at a time and remain on for 3sec then relay C automatically disconnect the load C from the circuit. So remaining loads were still operative. In conclusion the main objective of the project was achieved without any error since it was a simulation.

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