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Automatic Active Phase Selector

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Abstract – Continuity of power supply is very important factor in our day to day life. Interruption in the power supply even for few seconds can lead to huge loss in the industries and also in various other sectors where there is need of three phase supply like schools, colleges, offices etc. This problem can be overcome by using a circuit which automatically shifts the phase to another phase whenever there is failure in any one of the three phases. The most important of implementing this circuit is that it does not need any power supply. Overall it is one-time investment and results are for long term. Also there is no interruption in supplyand the power is provided continuously in the emergency conditions.

Keywords- *Automatic phase selector, power failure, interruption in single phase.*

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I. INTRODUCTION

It has been experienced that power failure in single phase out of the three phases is common problem. Most of times power in one of the three phases goes off, due to this interruption, industries have to face huge losses not only industries but other sectors like banks, offices or hospitals also faces the same problem. So to have a solution on this there are some circuits which provide the backup supply like generators, also there are some changeover switches but this are manually operated and causes waste of time and energy. Hence we have designed a circuit which is fully automatic and can shift the supply of one phase to another in very less time.

This paper is designed to check the availability of any live phase, and the load will be connected to the particular live phase only. This paper is designed with Arduino UNO ATmega328. This controller continuously checks for live condition of all phases connected to it and the controller connects the load to the active phase using a relay. This relay is driven with a transistor. If two or three phases are live, the load will be connected to the particular live phase only. An LCD is provided to display the status of the phase condition. In this paper we have regulated 12V, 500mA power supply, three terminal voltage regulator IC 7805 which is used for voltage regulation and bridge type full wave rectifier which is used to rectify the AC result of secondary of 230V/12V step down transformer.

II. DESIGN TOPOLOGY

The automatic phase selector is a device that links the load and the other phases and relay switches allowing the usage of the remaining phases where there is outage on the mains source without disturbing or interrupting the load. The device maintains constant power supply to the load by automatically activating the phases when the need arises. Following fig. 1 shows the block diagram of automatic three phase power selector.

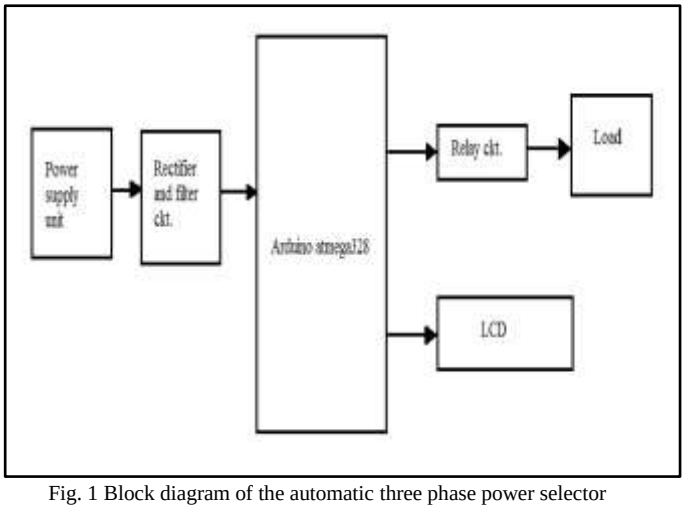

Fig. 1 Block diagram of the automatic three phase power selector

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III.DESIGN METHOD

The major building blocks of this paper are as follows:

A.Power Supply Unit

This serves as input unit to the system because AC mains enter the circuit through this point. In this unit, power is converted from A.C to D.C and filtered as shown in fig. 2. This unit also provides a regulated supply voltage to Arduino. [5]

The operation of the power supply unit occurs in three stages; the transformer stage, rectifier stage and filter stage.

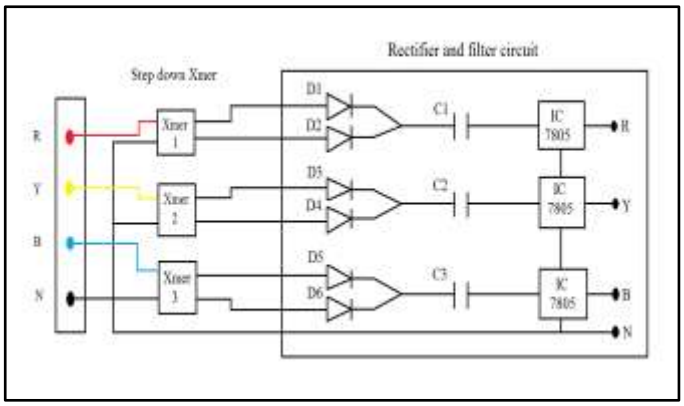

Fig. 2 Circuit diagram of three phase supply Unit

1) Transformer Stage

This section consists of three step-down transformers (240V/9V). The rating of transformers was chosen because of the conversion of 240V to 9V AC which was the circuit requirement. [5]

2) Rectifier Stage

In rectifier section, diodes were configured in a full wave bridge rectifier so as to boost the circuit efficiency. The rectifier converts 9V AC voltage from the Supply from the transformer result to 9V pulsating DC. During circuit operation, diodes conduct and produce a positive cycle that is forward biased, while in negative cycle, diodes becomes reversed biased. But since load current is in the same direction in both half cycles, full wave rectifier appears across the result terminals. [5]

3) Filter Stage

An electrolytic capacitor is used to filter the pulsating D.C voltage that comes out from the rectifier section. The capacitor charges up (i.e store energy) during conduction of half cycle thereby opposing any changes in voltage. Hence, filter out voltage pulsations. Thus this voltage is then sent to the voltage regulator IC where we get the regulated voltage of 5V DC. Following fig. 3 shows the actual rectifier and filter circuit. [5]

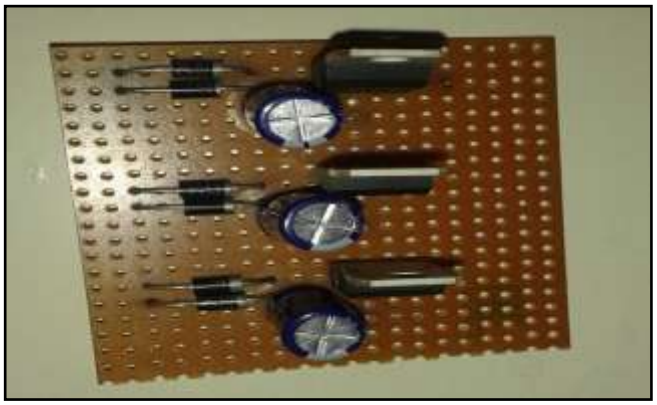

Fig. 3 Rectifier and filter circuit

B. Arduino and Lcd Connections

The Arduino is the heart of the paper. It automatically controls the whole operation through programing. The supply from the rectifier filter circuit is given to the Arduino. Arduino then shows all its working condition on LCD display. The result from Arduino is also given to relays so that the relay operates according to the command given. Thus whenever there is fault in any phase the load is automatically shifted.

The pin D0 and D1 of Arduino are given to the pin R/W and enable of LCD respectively. The four data pins of Arduino are connected to the four data pins of LCD. The Vcc and GND are common in both (Arduino and LCD). Following fig. 4 shows the connections of Arduino.

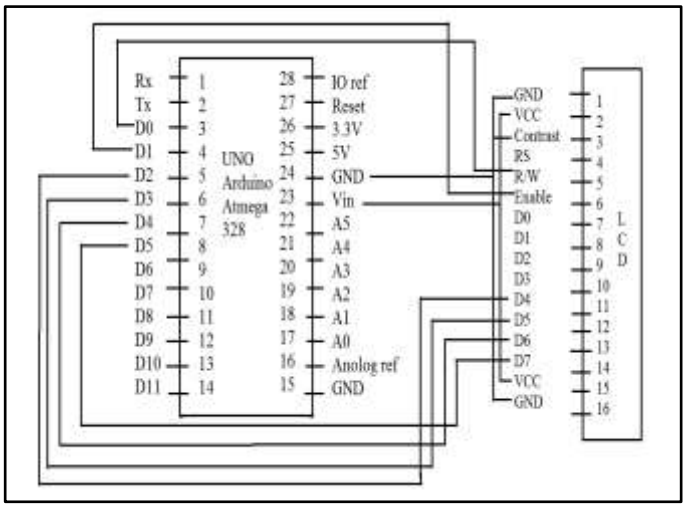

Fig. 4 Arduino connections

C. Relay Circuit

The whole switching of the paper depends upon the relay circuit. Relays are used as a switching device which helps the load to switch automatically on another phase when there is phase failure.

Here we have used six relays; two relays for each phase. These relays have three terminals NC (Normally close), NO (Normally open), and common terminal. Following fig. 5 shows the connection diagram of relay

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circuit. In this the three loads are connected to the common terminal of relay 1, relay 3 and relay 5 each. The phase R, Y, B is connected to the NC terminal of relay 1, relay 3 and relay 5 respectively. Also the phase Y, B, R is connected to the NO terminal of relay 2, relay 4 and relay 6 respectively. The common terminal of relay 2 is connected to the NO terminal of relay 1. Similarly, common terminal of relay 4 is connected to the NO terminal of relay 3 and common terminal of relay 6 is connected to the NO terminal of relay 5.

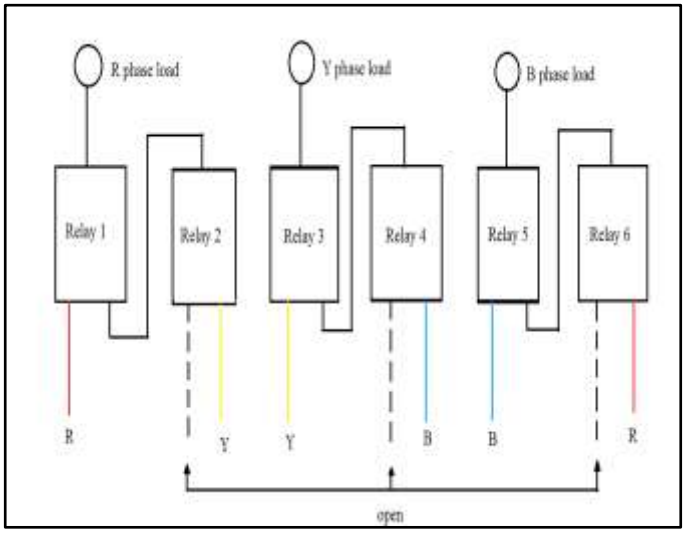

Fig. 5 Relay circuit

IV.WORKING

The following phases that are shown in above fig. 6 are used in alternating current power transmission and distribution and are denoted as:

(i) First phase which is referred to as red phase (R).
(ii) Second phase which is referred to as yellow phase (Y).
(iii) Third phase which is referred to as blue phase (B).

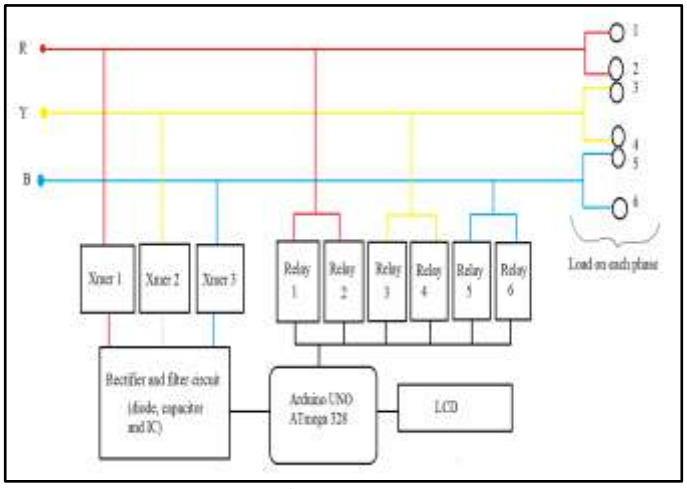

Fig. 6 Basic diagram of automatic active phase selector

This paper is designed to shift the small load and not the big load. Whenever there is emergency and any one phase of the three phase falls down this paper is of great use, since this paper shifts the critical load automatically and that too in less time. So here we have used six load two on each phase. Out of the two loads one is normal load and another one is critical load, so here total three loads are normal load and three loads are critical load.

The operation starts with converting the 230V, 50Hz AC supply to 9V, 50Hz i.e. step downing the main supply as per the need of the system. Then diodes are used to convert AC to DC which are fully rectified to get pulsating DC but to filter this pulsating signal from the diode a filter capacitor 470uF is used to get pure DC. This is given further to the voltage regulator and is also provided to Arduino ATmega328 which works on DC supply. Regulator 7805 IC converts 9V to 5V. The direct supply is also given to the loads for their normal operation.

The constant DC supply is thus given as an input to the Arduino since Arduino is an electronic device it works on 5V DC supply. Arduino also required external supply which can be given by using adaptor. The result of Arduino is given to LCD and relay circuit.

During normal operation that is when all the phases are in live condition all the load are ON and they are working on their respective phases. The working condition of the phases can be seen on LCD. But when the fault occurs on say ‘R’ phase then the relay operates and the critical load will be switched automatically on ‘Y’ phase. When the fault is removed the system begins to work normally. Also when there is fault on say ‘Y’ phase then the load is shifted on ‘B’ phase. Similarly, the load on ‘B’ phase is shifted on ‘R’ phase. The sequence of the switching can be changed according to the
connections made and the program installed. Fig. 7 shows the whole image of actual paper.

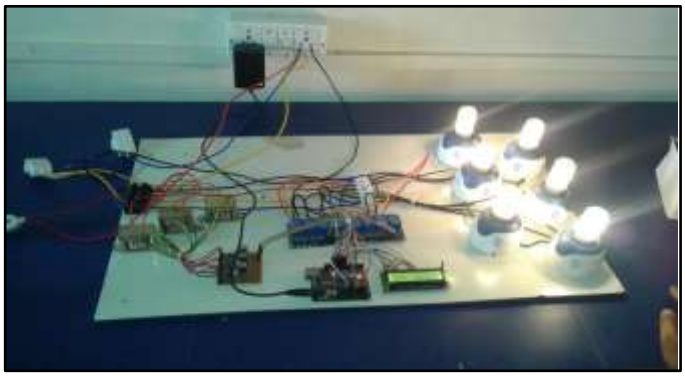
Fig. 7 Actual model of automatic active phase selector

V. RESULT

After testing of the paper it has been found that this system is applicable only when there is fault in any one phase of the three phases and not applicable when more than one phase fails. Thus the following table II shows the result of the paper.

TABLE I. RESULT OF PAPER

Phase R	Phase Y	Phase B	Operating Condition
1	1	1	Normal working condition
0	1	1	R shifted on Y
1	0	1	Y shifted on B
1	1	0	B shifted on R
0	0	1	NA
1	0	0	NA
0	1	0	NA

VI.ADVANTAGES

1. Provides continuous power supply.
2. Times required for switching between the phases has been drastically reduced.
3. More automatic operation with the elimination of selector switch.
4. Reduced circuit size and easier implementation with the use of relay driver switch.
5. The problem of sparking between the selector switch and the phase connection does not arise.
6. No manual errors.

VII. DISADVANTAGES

1. Required skilled person.
2. Applicable only during the fault in one phase.
3. Used to shift small load only.

VIII. APPLICATION

This paper can be used where there is need of continuous power supply. Even if interruption of few second can cause a huge loss this paper is best suited. Such cases include -

1. Hospitals operation units
2. Banks
3. Industries
4. Schools/ college libraries
5. Govt. offices/ institutes

XI. CONCLUSION

Using this paper, a correct voltage level at result is provided to the required phase. In-short the uninterrupted power supply can be provided. The circuit also provides an automatic phase change in the system (i.e. R, Y, and B). Hence using this circuit human effort is reduced and the motive of phase change is achieved automatically with the help of advanced controller that is Arduino which leads to various industrial and commercial usages. In short it is an intelligent system which has the ability to monitor, control and switch the system between phases. Ultimately by implementing such a circuit the power failure issues are resolved and also human efforts are reduced.It is also less expensive and easily available. It reduces the stress and saves time. It also provides better protection as compared to the manual practice because of the use of overload is the changeover system. However, this design can be improved for future work.

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