Automatic Phase Changer with Optimal Selection

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***Abstract*— This research is developing an automatic phase selector which acts as a back up to the power supply when any of the main lines fails. In single phase lines when any of the line fails the power will not be available. This device mainly reduces the wastage of power and time. It has the capability of selecting the line with power when any of the lines fails and also select the line with the highest voltage in the case of low voltage. The switching is done automatically which has a capability to reduce arcing which occurs in three phase lines due to mechanical switching. The required trigger pulses for the switches are obtained by using transistors.**

***Keywords*- Microcontroller, Phase Selection, Power, Automatic changer**

I. INTRODUCTION

At first, 3-stage voltage changer system developed was manually operated and its time waster and not convenient. The enthusiasm of automatic 3-stage voltage changer system is on the fact that innovation headway has made it conceivable to minimize cost, hard work and time squandered, and furthermore improves the unwavering quality of our electrical and gadgets system. Subsequently with the assistance of electromechanical switching system through the principle of solenoid, a system has been planned to such an extent that electromechanical device like a relay and contactor is arranged to consequently change from one phase to other without human mediation. This design is of high effectiveness and exceptionally exact in its performance, this is on the grounds that switching is done automatically immediately. The 3-phase automatic voltage changer system utilizes dependable electrical and electronics parts, for example, relays, transformers, contactor, diode, capacitor, resistor and other switching components.

The operation of this system is that whenever there is failure in any of the line leading to no output voltage, it select automatically to other phase immediately. This device is applicable in homes, manufacturing plants, corporate workplaces and business center. This system also transfers maximum power to the load.

A. Aims this of the Study

The main aims of this research is as follows:

1. To select automatically a voltage that is present in power line.
2. To avoid stress and inconvenience in manually selecting of phase voltage.
3. To build a system that can be able to choose any voltage that appears to be of high potential among other voltage.

B. The Scope of the Study

This work is to select automatically AC phase voltage supply from PHCN. This doesn't include change over switch from power authority to generator switch. It additionally assists with choosing the appropriate voltage required. This exploration is intentionally design for AC voltage as it were.

C. Need for Automation

In order to change from one phase to other manual operation is not possible as we are dealing with 3-Φ 415V supply which causes fire accidents during change over and leads to 3-Φ faults which is dangerous to electrical equipment. More over manual phase changing is difficult to achieve at times as identifying the phase of power interruption is difficult. To avoid these difficulties we need automation which is done by "PHASE SELECTOR". Here we do not need any manual work and we are no way concerned with the phase of fault as the digital phase selector automatically switches to the phase where the power is available.

II. METHODOLOGY

In this research work, the basic ideal is that the load is transfer on different phase by the phase selector which select the phase according to availability and voltage level of phase. The system was implemented in five units as shown below

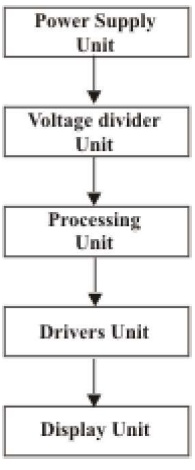

Fig. 1: System Implementation diagram

III. SYSTEM DESIGN AND IMPLEMENTATION

The system design and implementation was carried out according to the system's block diagram below:

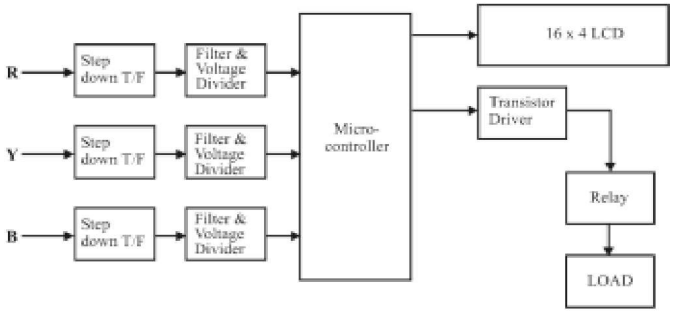

Fig. 2: Block Diagram of Automatic Phase Changer with optimal selector.

A. Phase Voltage Sensing Unit:

A voltage sensor is a sensor is used to calculate and monitor the amount of voltage in an object. Voltage sensors can determine both the AC voltage or DC voltage level. The input of this sensor is voltage. This unit consists mainly of the power supply and the sensing unit. It is at this stage that the three phase supply voltage is converted from ac to dc, filtered and through a voltage divider to the microcontroller.

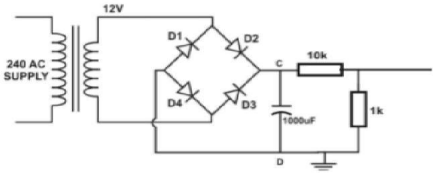

Fig. 3: Phase Voltage Sensing Unit

B. Microcontroller Unit

The processing unit comprises of PIC16F877a microcontroller where all the logic operations are being carryout. The programmed logic in MCU operates by sensing the three different phase reduced filtered dc voltage obtained with the help of voltage divider and processes the information.

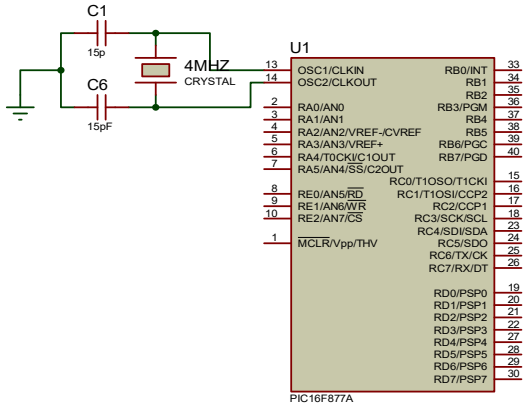

Fig. 4: Microcontroller Unit

C. LCD Display Unit

The LCD display unit displays the state of the resultant phase voltage switching and digital selection of the system. It comprises of a Liquid Crystal Display unit [LCD], 16 x 4 module which is interfaced with the microcontroller used to display the selected healthiest available phase to feed the load as it is processed. This indicates the various outputs of the microcontroller in a digital form that can easily be comprehended by the observer. It displays the set point, process variable and the current status of the entire system.

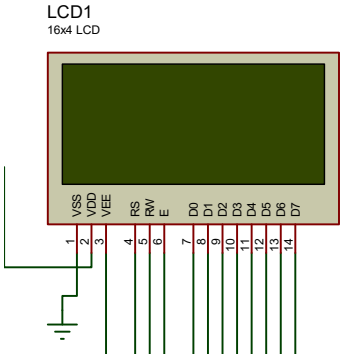

Fig: 5: Display Unit

D. Switching Unit:

The Switching Unit is in charge of the make and break contact in every electrical system. However, this unit consist of drivers and actuators. The drivers are made up of [BC337] transistors which operate to drive the relay. Other devices used are relays as the active components and resistors, diodes as the passive elements. The output from the processing unit switches ON the respective transistor which in turn actuates the relays. The incoming phases from the public utility supply are connected to the respective relay terminals and the single phase output to the load is also interfaced with the relay outputs.

Circuit Mode Of Operation

The Automatic Phase Selector and Changeover circuit consist of three transformers T1, T2 and T3 which are connected to each phase from the public utility supply. These transformers step down the phase voltage from 240V ac to 12V ac. The full wave bridge rectifier circuit is used to convert the 12V ac stepped down voltage to 12V dc pulsating voltage. This 12V dc pulsating voltage is filtered with the presence of an electrolytic capacitor into a pure 12V dc. The 12V dc is further stepped down to a maximum of 4V dc by a voltage divider network as shown in the circuit below.

The stepped down 4V dc voltage is feed into the PIC16F877a Microcontroller Unit for onward comparison and processing. The programmed logic resident in the ROM of the Micro controller unit does all the processing of the dc voltage and passes the signal for the phase with the healthiest available

phase (most stable, safe and available). The processed signal is sent to the respective pin which actuates/trigger the switching circuit interfaced with it to feed the load without any notice of power outage.

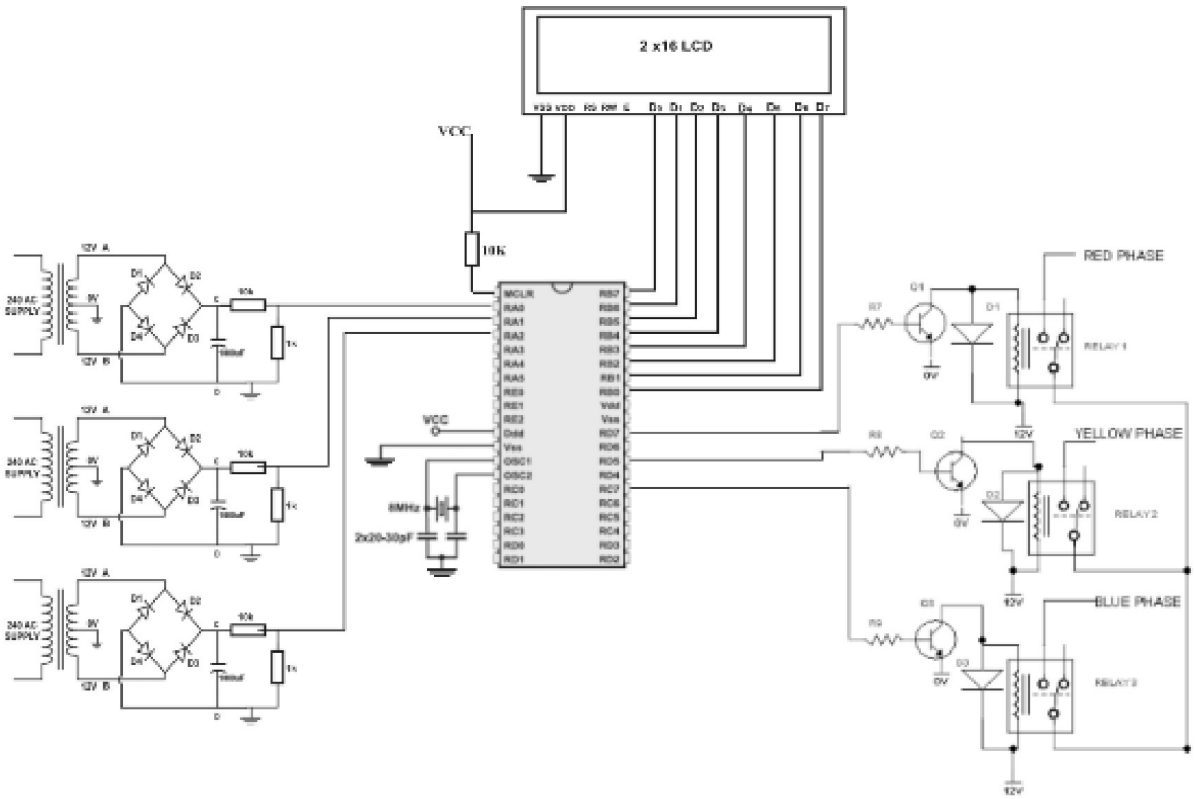

Fig.6: circuit diagram for the automatic power election switch

IV. SYSTEM DEVELOPMENT

The designed circuit of the automatic phase selector switch was simulated on Proteus, after which the circuit was wired and a model developed as shown in Fig. below

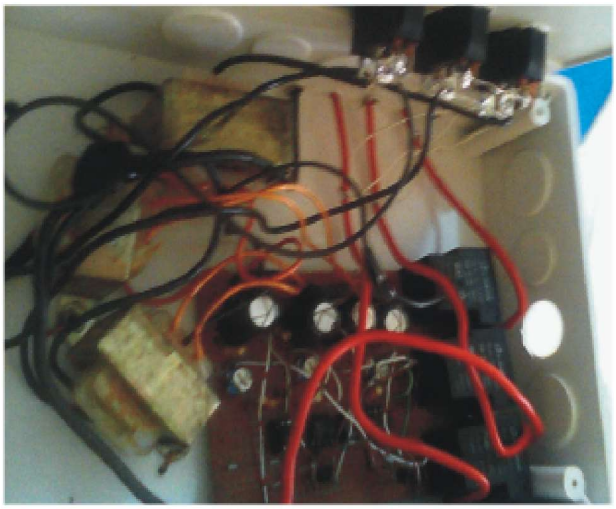

Fig. 7: system development

V. RESULT

Phase priority selection test was performed on the implemented work to determine the efficiency of the design. This test was done by first, supplying power to all 3-phases and sequentially removing the power supply from each phase. Table1 show a logical result of the test where "1" indicates power availability in the phase or the phase is operating between 180V to 220V AC. While "0" indicates power outage in the phase or the phase is operating below 180V or above 220V AC supply.

Table 1: Logical Result of test carried out

Red Phase	Yellow Phase	Blue Phase	Output	Active Phase
0	0	0	OFF	None
0	0	1	ON	Blue
0	1	0	ON	Yellow
0	1	1	ON	Yellow
1	0	0	ON	Red
1	0	1	ON	Red
1	1	0	ON	Red
1	1	1	ON	Red

The circuit of the automatic power selection switch is designed to switch from one phase of power supply to another in an event of power outage in the serving phase or in the event of under or over voltage as programmed in the microcontroller. This was confirmed by varying the input voltage using a variable resistor, it was seen that the best phase with the best phase voltage was selected.

VI. CONCLUSION

In this paper, an automatic phase voltage changer switch with optimal selection was developed to help control electrical power supply to electrical load, with the aim of preventing the load from damage as a result of under and over voltage supply. The performance of the designed work as demonstrated by the prototype shows high efficiency of operation with respect to the desired aim.

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REFERENCES

[1] Abdullahi Abuh. " Microcontroller Based Automatic Power Selection Switch." IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) 14.1 (2019): 35-41.

[2] Ofualagba, Godswill. Design and Simulation of Automatic Phase Selector and Changeover Switch for 3-Phase Supply. International Journal of Novel Research in Electrical and Mechanical Engineering. 4. 28-35, 2017.

[3] Oduobuk, E., Ettah, E., Ekpenyong, E., Design and implementation of automatic three phase changer using LM324 quad integrated circuit. International journal of engineering and technology research, 2(4), 1-15, 2014.

[4] A.B. Ogundare, and M.M. Ihiovi, Design of a three-phase change-over switch using PIC16F877A microcontroller, International Journal of Engineering and Advanced Technology, 6(5), 2017, 24-27.