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3-Phase Switching System with Relay Mechanism.

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Abstract - *This is known as phase absence, absence of phase or drifting phase, and this is something that we come across in just about any industry, home or office setting. In a three phase supply it is often possible that one or two out of the three phases are not live. Due to this, at one time or the other, some of those electrical appliances will be on in a particular room, while they will be OFF in another room. This is disruptive to a common workflow as most activities will have to change to accommodate the new norm. Further more there's daily increase in load demand; the challenge that is facing most of the consumers is power failure. Because of this power break lot of havoc is wrought on household gadgets and sometimes even life. The difficulty of power pause rises from single phase faults in a distribution system but power is available in other phases. As it can be noticed, most of the domestic loads are intermittent, and normally have a spanning life smaller than the lifespan of the distributed generation plant, we find that they are connected to a single phase supply and if this fault occurs on any of the phases and the power is available in the other phases we cannot make use of this power. Other considerations One would therefore require to switch from one phase to other and auxiliary supply at any one time there is power failure in the one or the three phases of the power supply.*

Key Words: 3-Phase Switching System, Relay Mechanism, Manual Phase Selection, Bridge Rectifier, Continuous Load Supply and Power System Reliability.

1.INTRODUCTION

As a result of the number of interruptions in developing countries such as India, the solutions being proposed are more concerned with the availability of power for both essential and non-essential loads. Suboptimal generation capacity is a primary issue; power outages frequently occur and affect both the private and public sectors, including industries, banks, hospitals, and many other establishments. These establishments have the critical loads that must continue to be supplied power all the time to optimize operations and avoid unnecessary This VP is a response to the task by introducing the automatic Three-phase selector system which ensures that there is easy and an immediate change over of power between different sources and loads. The automatic selector is programmed to remain on alert for the supply voltage signals that fall below a level which is sufficient to drive the electrical or electronic devices. As a result of the comparator circuit voltage levels across all the three phases will be assessed. If any two phases running at then the selector moves the load from the mains to the backup generator or the other source. However, the automatic selector system has provision that the feedback current to the load when powered by other sources does not affect the operation this makes it safe to use and ensures continuity. In addition, about power sources it keeps the synchronized status and does not allow varying or rms fluctuations. imbalances during the transition between the two of them. This anti momentary transition ability is critical in circumstances where constant power is important or a must have by sparing the time of the relevant business functions from having to handle power blacks outs. Implemented as an automatic three-phase selector, the system provides a near-single supply power transfer with limited interruptions of service and maximum efficiency in the sector's consumptions while promoting the constant operation of the necessary services despite the instabilities in power delivery. It is apparent therefore that this system has this significant function of filling voids between supply fluctuations and demand for consistent reliable and steady electric power in the various areas of application.

2. LITERATURE REVIEW

[1] DESIGN OF AN AUTOMATIC POWER PHASE SELECTOR: The three phase power system for design comes with an auto selection of speed depending on the areas that may require the smooth power supply. Such systems are expected to construct spaces with steady light where it is feasible to shift to the stable potency or to the reserve power source (like a generator) every time the space is not actively used. Note that, unlike the antiquated electromechanical systems that take time and also require additional hardware, microcontroller based systems (as described in the work of Udoha & Of ualagba) are fast, re-programmable, and dependable. The main components are the power meter for sensing the power consumption with high precision, microcontroller (AT89C51), relays to switch the power and an LCD for status; all these combine to produce an energy effect. This automatic solution has been established to help in cutting down the time that is taken in the causing of the opportune time in the businesses as well as in homes. At the same time, despite the high cost and complexity of digital equipment, high reliability of the equipment and the quality of its protection make these systems quite effective, the use

of which can be enhanced in areas where there is a reliable power supply, and it can be combined with other energy sources. such as a generator) when idle. While traditional electromechanical systems are limited by slow time and increased hardware, microcontroller-based systems (as detailed in the work of Udoha and Of ualagba) are fast, programmable, and reliable. The main components include a power meter for accurate sensing, a microcontroller (AT89C51), relays for switching, and LCD for status; all working together to create an energy effect. This automatic solution has been proven to reduce downtime and increase efficiency in businesses and homes. Despite the cost and complexity of digital equipment, the reliability of the equipment and the quality of its protection make these systems very useful, improving their use in areas where there is a reliable power supply, especially since it can be combined with other energy sources.

[2] AUTOMATIC THREE PHASE CHANGER: The paper "Automatic Three Phase Changer" by Jaina, Rajawat, Sharma, Nagar, and Raj is in response to the power issues affecting developing countries such as India with focus on single phase to three phase faults that account for around 70% of all power systems. Because domestic loads dominantly draw single phase supply, any power failure in one phase means a waste of available power in two other phases. Present practice of manual switch gears causes undesirable results and become sources of potential hazards such as fire since the supply voltage is 415V. The authors present an auto power system that supervises and transitions to the accessible phase in a given circuit if the phase is lost; hence ensuring the supply is continuous. The proposed automatic three-phase changer utilizes transformers, relays, zener diodes, and capacitors in constructing a safer and better phase selection circuit that may be useful in residences, businesses, factories, and other facilities. The paper among others provides a system design and build process that focuses on its application in areas that experience high and fluctuating voltage drops.

[3] DESIGN OF AUTOMATIC CHANGE OVER SWITCH WITH GENERATOR CONTROL MECHANISM: The paper under the title: "Design of Automatic Change over switch with Generator control Mechanism" provides a feasible solution to all those countries that suffer from inconsistent power supply including Nigeria and many developing countries in the world. The authors L.S. Ezema, B.U. Peter, and O.O. Harris discuss the issue of constantly fluctuating power supplies that require the use of backup power such as generators. Their Automatic Change Over Switch they use to identify a situation of failure of the main electric supply then it would power the generator supply and switch to main electric supply when available again. This design reduces the need for people to interfere hence cutting on incidences of errors that may affect the equipment. The changeover switch system is composed of a phase failure detector and delays which are vital in facilitating the transition from one power source to another. The delay particularly assist to avoid direct back switching to the mains power in order give the stability confirmation before reconnecting. This design consideration is an important one for reducing the amount of wear that is imposed on the mechanism of the switch and on the generator, thus improving their durability. In addition, the authors describe the operational characteristics of the generator used when paralleling with the changeover switch; details of the generator battery, starting mechanism, and the cables interconnecting the two systems being provided. Listing these specifications, the paper underscores the necessity of incorporating optimised systems and parts for effective control of electrical loads and conditions. Overall, based on the findings of this paper, it can be recommended that an automatic changeover switch with generator controls not only guarantee the availability of power but also raise the reliability, comfort and performance of power systems. The authors suggested the future works among which are introduction of overload protection features to make this solution suitable for different industries and domestic uses.

[4] DESIGN AND SIMULATION OF AUTOMATIC PHASE SELECTOR AND CHANGE OVER FOR 3 -PHASE SUPPLY Basically, this article clearly describes design and simulation steps of automatic phase. This project work focuses on the design and construction of automatic phase selector and changeover switch for three/ three phase power supply. It acts a an means of change over from one phase of AC mains to to another in case one phase fail, and it also change to generator if all the phasing fail. over switch for 3 -phase power supply. This makes it probable to transform from one phase of the AC mains to another in a case of failure in the current phase, it as well changes over to the generator if there is failure with all the three phases of the Ac mains as shown below .The circuit also detects back supply of any or all three phases of the mains an and switching over without any indication of the power failure. This project has therefore evolved on the above types of electromechanical device which has been in circulation for sometime now. This has therefore been done using 1 -of -4 analogue multiplexer (CD4052), and ADC0804 analogue to digital converter, AT89C51 microcontroller and relay switches.

[5] DESIGN AND IMPLEMENTATION OF ANDROID BASE AUTOMATIC PHASE SELECTOR AND OVERLOAD PROTECTOR USING GSM: Another element are automatic phase selectors with overload protection systems which meet the need for uninterruptible power supply especially in areas experiencing frequent power shedding. Convention phase selectors and overload safeguards for use in proposed vehicle shipped completed with ordinary push buttons or simple circuit breakers; modern models include microcontroller automatic switching to enable phase selection as well as protection against overload in shortest possible time without the need for human interferences. GSM integration for remote monitoring and control have

made these systems even better as they now offer features like alerting the users, control of overloads from remote places, particularly useful where the installation is distributed or in areas that are hard to access physically. However, the use of Android platforms in interface development has made these systems easy to operate by providing mobile applications as control interfaces for the systems which greatly enhance reliability and interaction. Altogether, all these advancements form a stable set of tools for regulating power consistency and preserving electrical loads from overloads, within an automatic switching system configuration with load management and potential remote access.

[6] AN IMPROVED MICROCONTROLLER BASED AUTOMATIC THREE-PHASE ANALYZER AND SELECTOR: In this Paper an attempt is made to review some of the trends in the modern developments of the automated phase selection systems and describe the inadequacies of the three-phase selectors and the requirements to the voltage selection range. Such microcontroller-based automatic three-phase analyzers and selectors described in Akpan, Orike, and Odeyemi (2019) overcome these limitations with those that include a keypad for setting a customizable switching range. Their work builds upon previous designs by enabling users to specify the desired voltage range, on the fly, without having to download a new firmware to the microcontroller because the specifications of the voltage requirements have changed. The authors also point out that due to the system's development based on Arduino technology it can choose a phase that suit the preset parameters which limit risks due to unsymmetrical voltage variations and phase drops that can cause damage to electrical loads.Earlier work conducted by Ezema et al. (2012), Ashish et al. (2015) and Ezirim et al. (2015) offered valuable information on phase choice but did not offer much freedom in voltage regulation. Ezema and coworkers devised a system that either runs on main electrical power or calls for a generator power without much consideration for choosing between different three-phase sources. While modelling this, Ashish et al.'s model could accept solar, inverter and generator inputs but was lacking indicators for voltage values in the phase. Imminent characteristics include inability to detect fluctuating voltage levels that might translate to power drops in the low voltage phases; the study by Ezirim et al. created a phase availability based logic gate selector. These studies show that there is a need for more general systems like the one by Akpan et al. Where the system is capable of selecting the most appropriate phase in conjunction with power supply while the second phase is reached through user input for an appropriate voltage.

3. PROPOSED SYSTEM

As per my understanding, this block diagram indicates a three phase power supply which rectifies a 3 phase AC supply and provides out a DC output which further used to operating industrial load or the electrical equipment using relaydriver unit. Here's a step-by-step explanation of each block: Power Supply (3 Phase): These are the three-phase AC power inputs using three different phases, which includes; R,Y,B. R, Y, and B Phase Rectifiers: These blocks represent of one of the rectifiers for the phases (R, Y and B) in succession. This device is used to change the AC voltage, which appears in each phase, to DC voltage. Such arrangement makes it possible for each phase to have its own rectifier for purposes of converting the AC power to DC.Voltage Regulator & Filter Circuit: Then there might be some ripples on the DC voltage after rectification, and these ripples must be filtered. This circuity functions to control the voltage at the required output, as well as to remove noise and any oscillations and thereby supply the required DC voltage. Relay Driver Unit: The relief valves provided in this unit regulate the relay switches involved in the communion between the DC output and the industrial load. The relay driver turns on relays as required depending on the voltage available from the particular phase to effect this switch. Industrial Load, Electrical Equipment: This is the last load that depend on the DC power provided through the relay driver unit. It stands for the load which is the equipment or machinery that uses DC The load depends on a stable input. this diagram illustrate how an industrial load or equipment is powered with DC supply gotten from a three-phase AC supply.

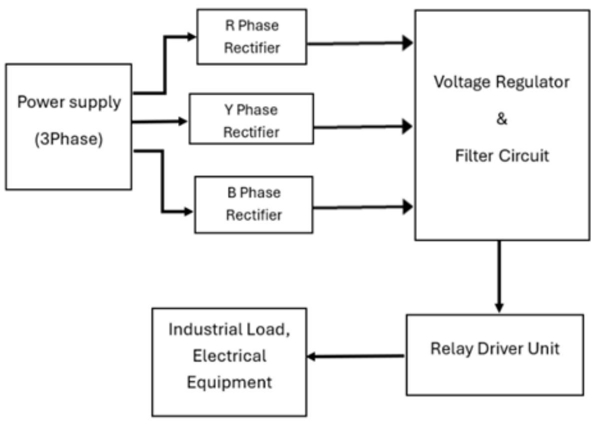

Fig 1: Block Diagram of 3- Phase Switching System

4. MATERIALS AND METHODOLOGY

4.1 Materials

This block diagram looks like that of a three phase power supply system where a three phase AC input is converted into a DC output which then powers an industrial load, electrical equipment through relay driver section. Here's a step-by-step explanation of each block: Power Supply Unit: Controllers power the switching system with an ac input that consists of three phases, creating an industrial-like power supply. Relays: Utilized for switching between phases. Electromechanical relays are typically chosen for high durability, switching capacity, and cost-effectiveness. The relays used should match the voltage and current specifications of the system. Selector Switches: For manually switching the phases on and off. It allows the operator to select the active phase depending on the requirements. PCB (Printed Circuit Board):As a reference point for connecting the relays and installing the bridge rectifier, we have designed it to be compact and able to connect directly to the main PCB. Bridge Rectifier: Rectifies the AC input from the three phase supply for measurement and control testing. Load Resistor: Implemented to understand how the system performs in other than normal situations. Wires and Connectors: For modeling interaction between the source of power, the relays, load resistor and other necessary parts. Simulation Software (e.g., MATLAB, Proteus, or Multisim):For the purpose of testing the working of the system and for observing effectiveness under different comprehensions.

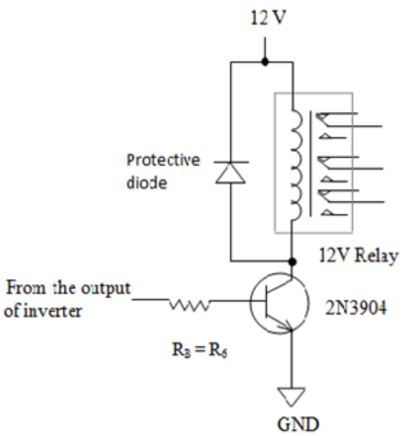

Fig 2 :Relay Driver Unit

4.2 Methodology

Power supply monitored in- three phases- We employ three transformers by which the voltage of each phase is regulated to an average of 5V. The voltage decrease is measured on which of the relays should be on or off. Relays are used to throw the phase supply from one line to the other. One transformer one comparator one transistor and one relay are incorporated in three similar circuits used; for each phase. In this paper, we outline how the circuit functions in the red phase, labelled as the 'R' phase. The phase R power supply is 12V, 300 mA which is obtained from transformer X1 after which its AC voltage is rectified and filtered by capacitor C1 through diode D1 to derive an operating voltage for the operational amplifier IC1. By using a voltage divider circuit comprising of a fixed resistor R1 and a preset resistor VR1, the inverting pin 2 of IC1 is supplied. For instance, the reference voltage can be changed by using the variable resistor, VR1 if necessary. During the phase R voltage, the voltage at IC1 inverting pin 2 is higher than a reference voltage of 5.1V, while the output at pin 6 remains high.The value of 5.1V for the non inverting pin 3 has been shown using a Zener diode (ZD1). Transistor T1 remains non-conducting and relay RL1 is demagnetized, keeping load L1 connected to Phase R by Nil contact of relay RL1. However if the voltage in phase R falls below 200V the voltage at pin 2 of IC1 is below the 5.1V reference and the output drops low. This makes transistor T1 conductive to turn on relays RL1, to isolate load L1 from phase R and connect it to phase Y through relay RL2.

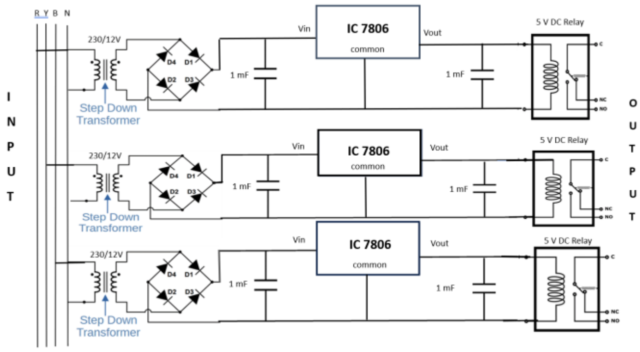

Fig 3: Circuit Diagram of 3- Phase Switching System

MATLAB Simulation for 3-Phase Behavior Analysis: The switching behavior of the 3-phase system under varying load conditions is traced and analyzed using a MATLAB simulation of the system. Create an electronic version of the 3 phase relay system by duplicating each piece of the relay system including relays, load resistors and switches. Perform several trials in MATLAB while recording voltage stability, phase transition, and its smoothness level, and overall efficiencies. By comparing the result obtained here to the behavior of the physical system, one can see that there are disparities in the two and develop the model again to match the behavior of the reality.

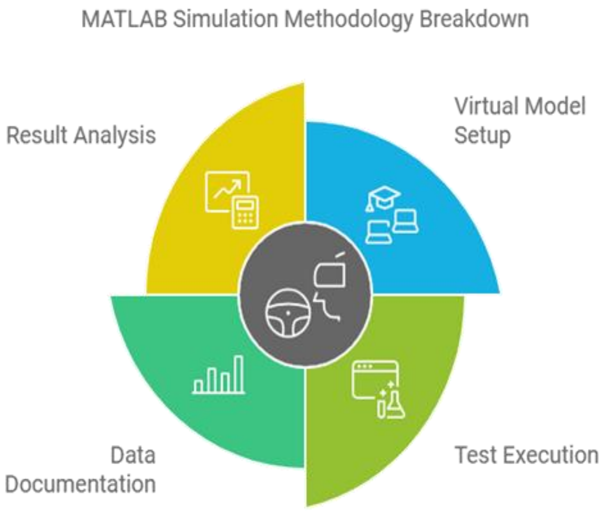

Fig 4: Matlab simulation block diagram of 3- Phase Switching System

5. RESULT AND DISCUSSIONS

As a example Normally, Under normal operation, each refrigerator unit is connected to its respective phase of supply. When the R-phase supply voltage drops below the rated value, the refrigerator connected to the R-phase is automatically transferred to the Y-phase. Similarly, if the Y-phase supply is unavailable, the refrigerator unit is automatically connected to the B-phase. Table X shows the transition of refrigerator units when switching between phases due to phase availability. This transition ensures that the refrigerator operates without interruption, preventing temperature fluctuations that could damage stored goods.

This automatic switching mechanism ensures that the refrigerator unit remains functional in the event of a single-phase failure. By implementing this system, the downtime of the refrigerator unit is minimized, ensuring consistent storage conditions.In a broader application, this phase-selection system can benefit households, small businesses, and facilities relying on uninterrupted refrigerator operation. The automatic switching system helps maintain the reliability of refrigerator units, especially in rural areas during adverse weather conditions like storms or high winds, where power fluctuations are common.

R	Y	B	R Phase Refrigerator unit	Y Phase Refrigerator unit	B Phase Refrigerator unit
1	1	1	R	Y	B
0	1	1	Y	Y	B
1	0	1	R	B	B
1	1	0	R	Y	R
0	0	1	B	B	B
1	0	0	R	R	R
0	1	0	Y	Y	Y
0	0	0	NA	NA	NA

Fig 5: Refrigerator Load Transition

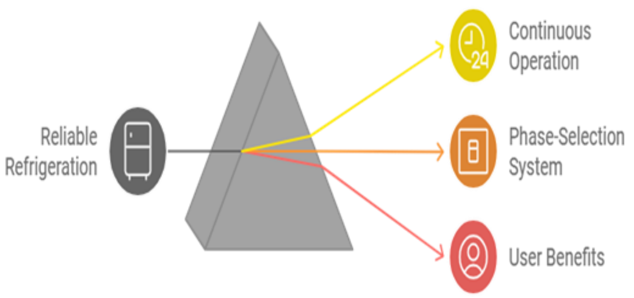

Fig 6: Refrigerator Load block diagram

Three-phase electrical system using RLC (Resistor, Inductor, Capacitor) components. The key points are:1. First Scenario (Purely Resistive Load): The three-phase system has a resistive load, meaning that the electrical current and voltage are in sync (in phase) with each other.The resistance in each phase is 1 ohm, making the magnitude of the current equal to the magnitude of the voltage.2. Second Scenario (Inductive Load): When the load has an inductive nature (e.g., a coil), the current lags behind the voltage. This happens because inductors resist changes in current, causing a delay.

The graphs of the results from MATLAB are the bottom shows how the voltage and current behave in both cases. In the first case, voltage and current waveforms match (same phase). In the second case, the current waveform lags behind the voltage waveform due to the inductive nature of the load.

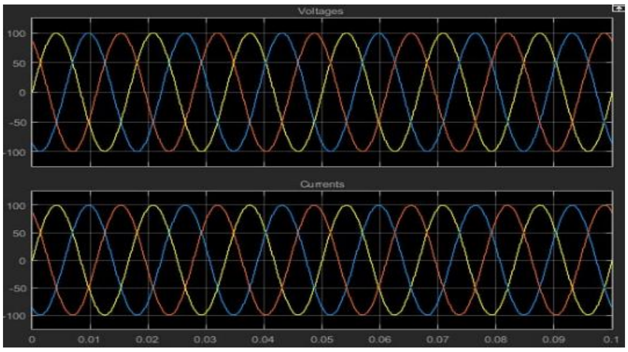

Fig 7: Resistive Load in 3-phase system

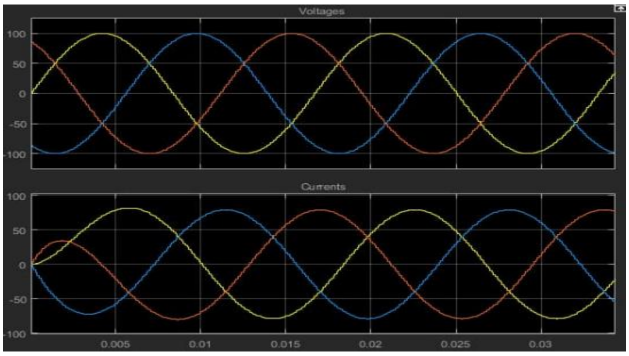

Fig 8: Inductive Load in 3-phase system

The 3 Phase Switching System with Relay Mechanism successfully ensures continuous power supply to the load during phase transitions, as demonstrated in the setup. The system's configuration allows for seamless switching between phases without interrupting the load, validating its effectiveness in maintaining stable power output under changing phase conditions. This consistent load supply highlights the project's reliability and practical application in scenarios requiring uninterrupted power through phase adjustments.

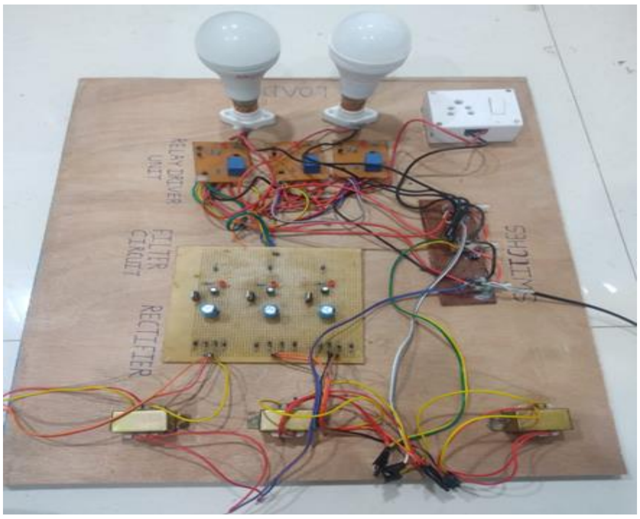

Fig 9 : Project setup of 3-phase Switching system

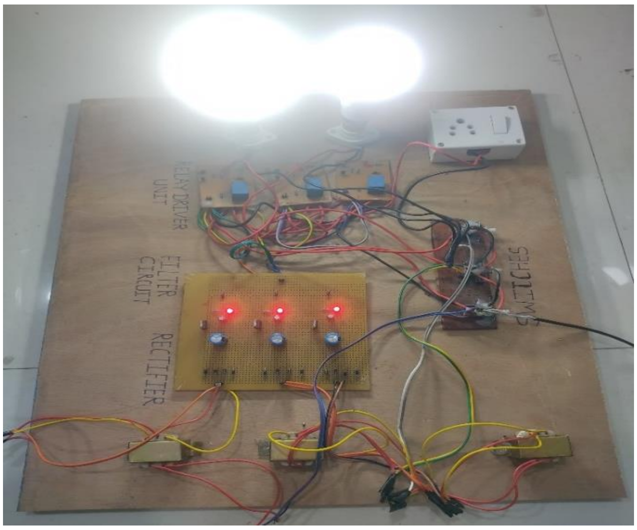

Fig 10 : output of 3-phase Switching system Project setup

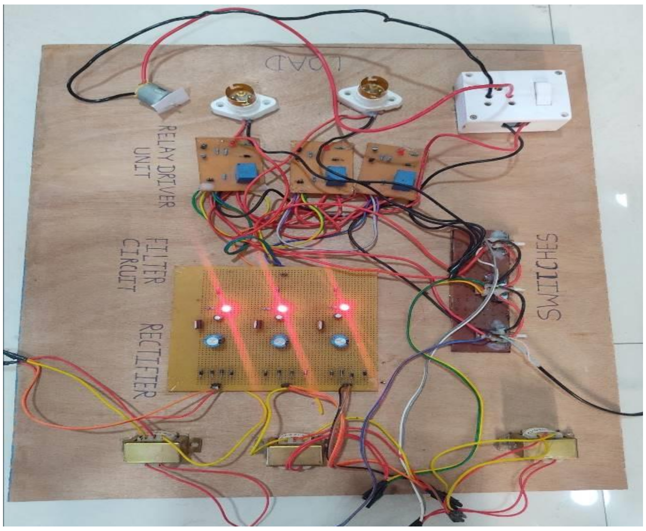

Fig 11: output of 3-phase Switching system Project setup

6. CONCLUSION

The main problem of manual selection of the phases in the 3 Phase Switching System is well solved by the author in the modified circuit proposed as the 3 Phase Switching System with Relay Mechanism which does not use the microcontroller. The system includes a circuit of subsequently connected relays and selector switches that allow to properly switch between phases nearly all the time, and even in case of phase failure. The MATLAB models, combined with physical experiments, ensured that the system was stable and responsive regardless of the load on its phases, and the delay was negligible during the phase shifts. The second advantage is the manual phase selection mechanism which is cheap and most importantly under the control of the user, however, in later designs, addition of automation to this mechanism would open more possibilities. In totality, this paper proves that the concept of a relay-based switching mechanism is a worthy option in discrened applications where phase management is done manually. Low level future work might include auto phase detection or continued investigation of relay endurance through extra testing to provide additional efficiency and usability.

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