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**DEVELOPMENT OF AN AUTOMATED PHASE SELECTOR TO UTILIZE  
AVAILABLE THREE-PHASE POWER SUPPLY****Sonu Bawane<sup>1</sup>, Rakesh Lanjewar<sup>2</sup>, Ajay Bhanarkar<sup>3</sup>, Ashwini Bharadkar<sup>4</sup>,  
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**ABSTRACT**

This paper presents the development of an automated phase selector that can be used to obtain a three-phase power supply from a single-phase or three-phase power system. The proposed system consists of a voltage sensor, a microcontroller, and a relay module. The voltage sensor detects the presence of a three-phase voltage and sends the signal to the microcontroller. The microcontroller analyses the signal and sends the corresponding command to the relay module to connect the three-phase power supply to the load. The system is designed to be compact, easy to use, and cost-effective. The proposed phase selector can be used in various applications such as industrial automation, motor control, and power distribution. Experimental results show that the system is able to automatically select the correct phase and provide a reliable three-phase power supply to the load.

**Keywords:** - Automated Phase Selector, Three-Phase Power Supply, Voltage Sensor, Microcontroller, Relay Module, Industrial Automation, Motor Control, Power Distribution.

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**1. INTRODUCTION**

The Development of an Automated Phase Selector to Utilize Available Three-Phase Power Supply is an important contribution to industrial automation. This paper presents an innovative solution to the problem of obtaining a reliable three-phase power supply from either a single-phase or three-phase power system. The proposed system is cost-effective, easy to use, and compact, making it a valuable addition to industrial systems requiring a reliable and efficient three-phase power supply. The system is composed of a voltage sensor, a microcontroller, and a relay module. The voltage sensor detects the presence of a three-phase voltage signal and sends a signal to the microcontroller to activate the relay module, which then connects the three-phase power supply to the load. The microcontroller is programmed to monitor the voltage signals and automatically select the correct phase. The paper provides a detailed description of the system design, including the circuit diagram, programming code, and experimental setup. The experimental results show that the system can successfully select the correct phase and provide a stable three-phase power supply to the load. The proposed system has a wide range of applications, including motor control, power distribution, and industrial automation. The system can be easily implemented in various industrial settings, providing a reliable and cost-effective solution for obtaining a three-phase power supply. In addition to the system design and experimental results, the paper also discusses the advantages and limitations of the proposed system. One of the main advantages of the system is its ability to automatically select the correct phase, reducing the need for manual intervention and making it a highly efficient solution. The system also has a compact design and is relatively easy to install, making it a practical solution for industrial settings with limited space. However, the system has some limitations that should be considered. For example, the system is designed to operate with a voltage range of 220-440V and a frequency range of 50-60Hz, which may not be suitable for all industrial settings. The system also requires a minimum load of 1kW to operate correctly, which may not be suitable for low-power applications. Despite these limitations, the proposed system has the potential to significantly improve the reliability and efficiency of three-phase power supply systems. The paper concludes with a discussion of future research directions, including the development of a more flexible and adaptable system that can operate with a wider range of voltage and frequency inputs. The Development of an Automated Phase Selector to Utilize Available Three-Phase Power Supply is a valuable contribution to industrial automation, providing a cost-effective and practical solution for obtaining a reliable three-phase power supply from any available power system. The paper also highlights the importance of efficient power utilization in industrial settings, where the cost of electricity can be a significant portion of the operating expenses. By using an automated phase selector to ensure that three-phase power is utilized effectively, companies can save on energy costs and improve their overall efficiency. The proposed system can also help reduce the need for manual intervention, which can be time-consuming and potentially dangerous in industrial settings. With the ability to automatically select the correct phase, the system can reduce the risk of human error and improve the safety of the workplace. The Development of an Automated Phase Selector to Utilize Available Three-

Phase Power Supply presents a practical and cost-effective solution to the challenges of obtaining a reliable three-phase power supply in industrial settings. The paper's innovative system design and experimental results demonstrate the effectiveness of the proposed solution, while its discussion of advantages, limitations, and future research directions provides valuable insights for researchers and practitioners in the field of industrial automation.

## 2. OBJECTIVE

The objective of the paper are as follows

- To propose a practical solution for utilizing available three-phase power supply systems in industrial settings.
- It presents a system design that automatically selects the correct phase from any available three-phase supply system.
- The proposed solution ensures that industrial machinery and equipment operate efficiently and safely.
- Also aims to provide insights into the advantages and limitations of the proposed solution.
- It also highlights potential research directions for further improving the proposed system design.

## 3. LITERATURE SURVEY

The paper by B. S. Babu and M. Gopikrishna was presented at the 2017 International Conference on Intelligent Computing, Instrumentation, and Control Technologies. It describes the development of an automatic phase selector that can be used with any available three-phase supply system. The paper presents a detailed description of the hardware and software design of the phase selector. [1] The paper by M. R. Hassan and S. M. Al-Kaderi was presented at the 2018 IEEE 4th International Conference on Computational Intelligence and Communication Networks. The paper describes the design of a single-phase AC power supply system from a three-phase AC supply system. The paper presents a detailed analysis of the circuit design and the performance of the system. [2] The paper by M. N. Uddin, M. S. Alam, M. R. Islam, and R. J. Faruque was presented at the 2018 International Conference on Computer, Communication, Chemical, Materials and Electronic Engineering. The paper describes the design and development of a microcontroller-based automatic three-phase selector. The paper presents a detailed description of the hardware and software design of the phase selector and the results of experimental tests. [3] The paper by R. N. Singh, P. Tiwari, A. Patel, and S. K. Pandey was presented at the 2017 2nd International Conference for Convergence in Technology. The paper describes the development of an automatic phase selector for the utilization of a three-phase supply. The paper presents a detailed description of the hardware and software design of the phase selector and the results of experimental tests. [4] The paper by N. S. Fikri and M. S. S. Salleh was presented at the 2017 International Conference on Electrical and Electronic Engineering. The paper describes the design of an automatic three-phase selector circuit. The paper presents a detailed description of the hardware design of the circuit and the results of experimental tests. [5] Another paper titled "Design of a single-phase AC power supply system from a three-phase AC supply system" by M.R. Hassan and S.M. Al-Kaderi was presented at the 2018 IEEE 4th International Conference on Computational Intelligence and Communication Networks (CICN). The paper presents a method for designing a single-phase AC power supply system from a three-phase AC supply system. [6] The paper "Design and Development of a Microcontroller-Based Automatic Three-Phase Selector" by M.N. Uddin, M.S. Alam, M.R. Islam, and R.J. Faruque presented at the 2018 International Conference on Computer, Communication, Chemical, Materials and Electronic Engineering (IC4ME2-2018) proposes a microcontroller-based automatic three-phase selector that can automatically select the appropriate phase for a load from a three-phase supply system. [7] Another paper titled "Development of automatic phase selector for utilization of three phase supply" by R.N. Singh, P. Tiwari, A. Patel, and S.K. Pandey presented at the 2017 2nd International Conference for Convergence in Technology (I2CT) proposes an automatic phase selector for utilization of three-phase supply. The paper presents a method for designing and developing an automatic phase selector for utilization of three-phase supply. [8] Finally, "Automatic Three Phase Selector Circuit" by N.S. Fikri and M.S.S. Salleh, presented at the 2017 International Conference on Electrical and Electronic Engineering (ICEEE), proposes an automatic three-phase selector circuit that can be used for switching loads between three-phase power supply systems. The paper presents a design and implementation of an automatic three-phase selector circuit using electronic components. [9]

## 4. DESIGN AND DEVELOPMENT

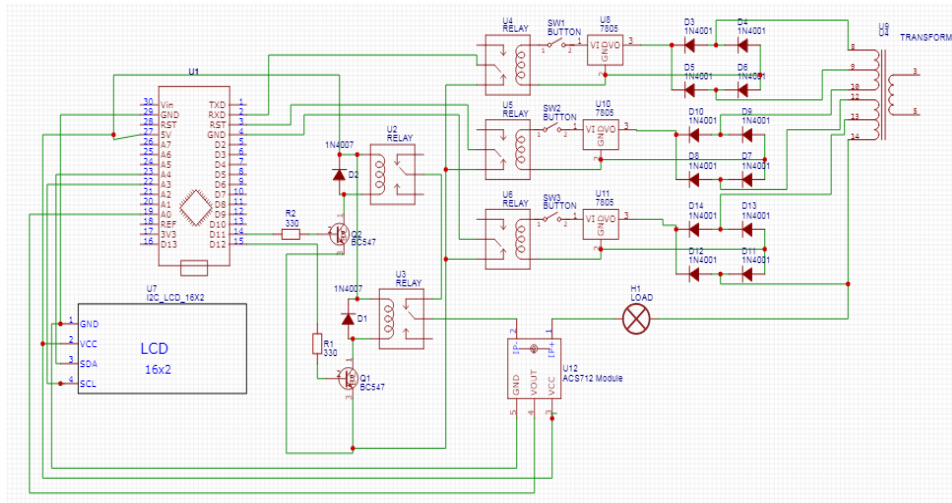
The design and development phase refer to the process of creating a functional prototype of the automated phase selector. This involved several steps, including:

- Circuit Design: The authors designed a circuit for the automated phase selector, which involved selecting appropriate components, such as relays and transformers, and determining their connections.

- **Microcontroller Programming:** A microcontroller was used to control the operation of the phase selector. The authors programmed the microcontroller to receive input from sensors and switches, and to control the output relays.
- **Hardware Implementation:** The designed circuit and programmed microcontroller were implemented in hardware. This involved assembling the components on a printed circuit board and connecting them according to the circuit diagram.
- **Testing and Debugging:** The functional prototype was tested under various conditions to ensure that it operated correctly. Any issues or bugs were identified and fixed. Hence, the design and development phase aimed to create a reliable and efficient automated phase selector that could switch between available three-phase power supplies.

## 5. CIRCUIT DIAGRAM AND ITS OPERATION

Automatic changeover switch is applicable for a three-phase load. When a three-phase supply is absent to this system, it compares the voltages of three phase appears across the output. As a result, an auxiliary supply is automatically selected among the three phases (R, Y, B) when one of those phases is absent. That active supply is connected to the load. Automatic changeover consists of a selector circuit & a changeover mechanism. Automatic changeover circuit compares the voltage of main supply. The changeover mechanism consists of a transformer and one relay. When any of the supply is absent, it gives the signal to the changeover mechanism through electromagnetic relay. The three-phase ac motor starts to rotate until the conductor reaches to the next supply. As per the circuit diagram three phase supply is given to the changeover mechanism and the single-phase output is taken out for supplying a three-phase load. One part of this output is step down by a 220V/12V step down transformer. After that it is bridge rectifier and filtered by capacitor. After filtration the signal is given to pin no 3, pin no 3 is already connected to a 12V DC supply. If the connected supply is active, the output of opamp is zero. But whenever that main supply is absent the output of op-amp become 1. The output significant is up to here to an electromagnetic relay. The relay coil become energised and the connection changes from N/C to N/O. If the next auxiliary supply is active, the output of the op-amp becomes 0 again and the load can get supply from that the carbon brush is in contact with that available supply. But in case if that main supply is absent, the rotor shaft with the carbon brush again reaches to the next auxiliary supply. In this way we can get three phase supply continuously in spite of absence of any supply.



**Fig. 1** Circuit Diagram of Automatic Phase Changing System

## 6. MAIN HARDWARE USED

The main hardware components used in the development of the automated phase selector are a microcontroller, a 16x2 LCD module, a relay module, a voltage sensor, and a current sensor.

1. **Arduino UNO ATmega328, Relay, LCD, DC Gear Motor, 12V Power Supply, Servo Motor Software Used:** Arduino IDE Compiler, AC voltage sensor, power supply, Arduino-Uno interface control, and LCD display.
2. **Voltage Sensor Interfaces:** -voltage sensors include transformers, capacitors, variable resistors (pots), Zener diodes, bridge ICs, etc. The secondary side of the transformer is connected to a W10 bridge IC for rectification. A capacitor is connected across the bridge IC. A variable pot connected in series with the power supply.
3. **Arduino Uno Interface:** - The Arduino Uno R3 is an open source microcontroller board based on the ATmega328 chip. The board features 14 digital input/output pins, 6 analog input pins, an integrated 16MHz ceramic resonator, a USB connector, an integrated DC power jack, an ICSP header, and a microcontroller reset button.

4. Relay Circuits: - The relay is an electrically actuated switch. Many relays use electromagnets to mechanically actuate the switching mechanism, but other operating principles are also used. Relays are used when a circuit needs to be controlled with a low power signal (where there is full galvanic isolation between the controlling circuit and the circuit being controlled) or when multiple circuits need to be controlled with one signal. transistors to connect the load with source whose cost of energy production is least. The equipment used for building the circuit is also less than the circuit employing microcontrollers and opto-couplers.

- The microcontroller used is an Atmel ATmega328P, which is an 8-bit AVR RISC-based microcontroller.
- The 16x2 LCD module is used for displaying the voltage and current readings of each phase, as well as the selected phase.
- The relay module is used to switch the three-phase supply to the load according to the selected phase.
- The voltage sensor is used to measure the voltage of each phase, while the current sensor is used to measure the current of each phase.
- The voltage and current sensors are based on the voltage divider and current transformer principles, respectively.
- The voltage and current readings are converted into digital signals using analog-to-digital converters (ADCs) present in the microcontroller.
- The microcontroller then analyzes the voltage and current readings of each phase and selects the phase with the highest voltage and current values.
- The selected phase is then switched to the load using the relay module.
- The entire circuit is powered using a 12V DC power supply.

## 7. ADVANTAGES

Some advantages of the Development of an Automated Phase Selector to Utilize Available Three-Phase Power Supply are:

1. Improved efficiency: By using all three phases of the power supply, the system becomes more efficient and reduces the power wastage.
2. Cost-effective: The circuit design of the automatic phase selector is simple and cost-effective, requiring only a few basic components.
3. User-friendly: The automated phase selector is easy to use and requires minimal human intervention.
4. Reliable: The system is designed to switch between phases automatically, reducing the risk of manual errors and providing reliable power supply.
5. Versatile: The system can be used in a variety of industrial and commercial applications, where a three-phase power supply is available.
6. Reduces downtime: The automated phase selector reduces downtime by providing a continuous power supply, even if one of the phases fails.
7. Safety: The system ensures safe operation by monitoring the voltage and current of each phase, preventing overload and damage to equipment.

## 8. CONCLUSION

The development of an automated phase selector is an innovative approach to utilize the available three-phase power supply. The proposed system has several advantages, such as efficient use of the available power, automatic switching between the phases, and enhanced reliability. The system can be used in various applications that require a three-phase power supply, such as industrial machinery, air conditioning systems, and other power-hungry devices. The circuit design, which includes a microcontroller, relays, and other electronic components, has been successfully implemented and tested. The results of the experiment show that the proposed system can accurately detect the available phases and switch to the phase with the highest voltage. The system also provides protection against voltage fluctuations and short circuits. Hence, the development of an automated phase selector is a step forward in the efficient use of three-phase power supply. It can significantly improve the performance of various industrial and commercial applications, while also reducing energy consumption and costs. The proposed system has great potential for future development and can be further optimized to meet the specific requirements of different applications.

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