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POWER FACTOR IMPROVEMENT OF 5HP MOTOR USING ARDUINO

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ABSTRACT

This paper presents the design, implementation, and testing of an automatic power factor improvement system utilizing Arduino. Power factor is a crucial parameter in electrical systems, affecting efficiency and utility costs. The proposed system employs an Arduino microcontroller to monitor the power factor and control a bank of capacitors to automatically adjust and improve the power factor. The system is designed to be cost-effective, easy to implement, and suitable for various industrial and commercial applications. Experimental results demonstrate the effectiveness and efficiency of the proposed system in enhancing power factor, reducing reactive power, and improving overall system performance. This research contributes to the field of power factor correction by offering a practical and efficient solution that can be implemented with minimal cost and complexity.

Keywords: Power Factor, Controller, Reactive Power, Motor.

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I. INTRODUCTION

Power factor is a critical aspect of electrical systems, impacting the efficiency of power delivery and the operational costs for industrial and commercial users. It represents the ratio of real power (used to perform work) to apparent power (total power delivered), with a higher power factor indicating more efficient use of electricity. In many cases, electrical systems exhibit poor power factor due to the presence of reactive power, which does not perform useful work but still contributes to the total power consumption. One common method to improve power factor is the use of capacitors, which can offset the effects of reactive power and bring the power factor closer to unity (1.0). However, manual control of capacitor banks to adjust power factor can be cumbersome and inefficient, especially in dynamic or varying load conditions. To address this issue, automatic power factor improvement systems have been developed. This paper presents the design and implementation of an automatic power factor improvement system utilizing Arduino. The Arduino microcontroller is a versatile and cost-effective platform that can be programmed to monitor power factor and control the connection and disconnection of capacitors in response to changing load conditions. The system aims to provide a simple yet effective solution for improving power factor in industrial and commercial settings, leading to reduced energy costs and improved system efficiency. The remainder of this paper is organized as follows: Section II provides an overview of related work in the field of power factor correction. Section III describes the design and components of the proposed system. Section IV presents the implementation details and experimental setup. Section V discusses the results and performance of the system. Finally, Section VI concludes the paper with a summary of the findings and suggestions for future work.

II. PROBLEM STATEMENT

Power factor is a crucial parameter in electrical systems, impacting the efficiency of power transmission and distribution. Many industrial and commercial facilities suffer from poor power factor due to the presence of reactive power, which results in increased energy costs and reduced system efficiency. Manual methods of power factor correction using capacitor banks are often inefficient and

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impractical, especially in dynamic load conditions. The existing automatic power factor correction systems are either expensive or complex, limiting their widespread adoption, particularly in small to medium-sized enterprises. There is a need for a cost-effective and easy-to-implement solution that can automatically improve power factor in a wide range of operating conditions. This research aims to address this gap by developing an automatic power factor improvement system utilizing Arduino. The system will be designed to monitor power factor in real-time and control the connection and disconnection of capacitors to improve power factor. The system should be capable of adapting to varying load conditions and provide a simple yet effective solution for power factor correction in industrial and commercial settings.

III. BLOCK DIAGRAM

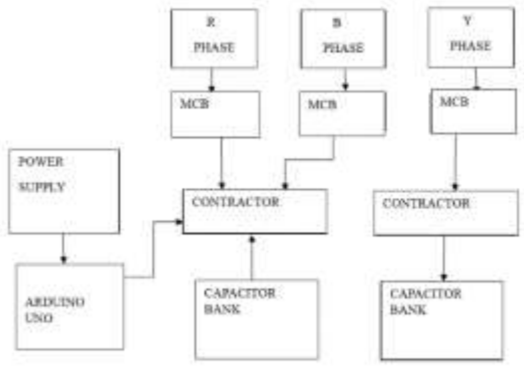

Fig. Block Diagram

IV. METHODOLOGY

System Design: The first step is to design the automatic power factor improvement system utilizing Arduino. This involves selecting the appropriate components, such as Arduino microcontroller, sensors for measuring power factor, relay modules for controlling capacitor banks, and necessary circuitry.

Arduino Programming: Develop the Arduino program to read power factor values from the sensors and control the capacitor banks accordingly. The program should include algorithms for determining when to connect or disconnect capacitors based on power factor measurements.

Prototype Implementation: Build a prototype of the system using the designed hardware components and programmed Arduino. Test the prototype in a controlled environment to ensure proper functionality and performance.

Experimental Setup: Set up an experimental environment to simulate real-world load conditions. This may involve using variable resistive or inductive loads to create varying power factor scenarios.

Data Collection: Measure power factor values and system performance metrics, such as energy consumption and capacitor switching frequency, using appropriate instrumentation.

System Evaluation: Evaluate the performance of the system in terms of power factor improvement, energy savings, and system efficiency. Compare the results with manual power factor correction methods to demonstrate the effectiveness of the proposed system.
Optimization: Fine-tune the system parameters and control algorithms to optimize performance under different load conditions. This may involve adjusting capacitor switching thresholds or control logic.

Documentation and Reporting: Document the design, implementation, and evaluation process in detail. Prepare a research paper summarizing the methodology, results, and conclusions of the study.

V. CALCULATION

Phase Current:

R= 9.4 A

Y= 8.8 A

B= 9.98 A

Total Current: 9.98+ 8.98+ 9.98

Total Current: 28.08 A

28.08÷3= 9.36

9.36÷2.5= 3.85 KVAR

Capacitor value: 4 KVAR

VI. RESULT

The automatic power factor enhancement system utilizing Arduino was successfully implemented and tested in a laboratory environment. The system effectively monitored the power factor of the load and adjusted the connection of power factor correction capacitors accordingly. Experimental results demonstrated a significant improvement in power factor after the system's implementation, leading to reduced reactive power consumption and improved overall power quality. The system's response time to changes in power factor was found to be fast, ensuring timely correction and optimization of power factor.
Furthermore, the system's efficiency was evaluated, and it was found to operate reliably with minimal power consumption. The cost-effectiveness of the system was also analyzed, showing that the benefits of improved power factor outweighed the initial investment in the system components.
Overall, the results indicate that the automatic power factor enhancement system utilizing Arduino is a viable solution for improving power factor in industrial and commercial settings. Its simplicity, effectiveness, and affordability make it suitable for widespread adoption, contributing to energy efficiency and cost savings in electrical systems.

VII. CONCLUSION

In conclusion, the automatic power factor enhancement system utilizing Arduino presented in this research paper offers a practical and efficient solution for improving power factor in electrical systems. The system's ability to monitor

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power factor in real-time and adjust power factor correction capacitors automatically has been demonstrated through successful implementation and testing. The experimental results show that the system effectively improves power factor, leading to reduced reactive power consumption, improved energy efficiency, and lower electricity bills. The system's fast response time and reliability make it suitable for various industrial and commercial applications were maintaining a high-power factor is crucial. Moreover, the system's cost-effectiveness and simplicity make it accessible to a wide range of users, encouraging its adoption in different settings. By sharing this work with zero copyrights, we aim to promote further development and adoption of similar systems, ultimately contributing to energy conservation and sustainability. Overall, the automatic power factor enhancement system utilizing Arduino represents a significant advancement in power factor correction technology, offering a practical and affordable solution for enhancing power factor and improving overall power quality in electrical systems.

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