International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** III **Month of publication:** March 2026

DOI: https://doi.org/10.22214/ijraset.2026.77462

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue III Mar 2026- Available at www.ijraset.com

IOT-Based Automatic Power Factor Correction with Real-Time Carbon Footprint Estimation

Amal Roy[1], Govind Anilkumar[2], Muhammed Najil K[3], Swaraj C P[4], Neena Skaria[5], Elizabeth Paul[6]
Bachelor of Technology in Electrical and Electronics Engineering, Mar Athanasius College of Engineering (Government Aided, Autonomous) Kothamangalam

Abstract: A Low-cost IoT-enabled Automatic Power Factor Correction (APFC) system with realtime carbon footprint estimation is designed and implemented using a Raspberry Pi Pico W microcontroller. The system continuously monitors the power factor of an electrical load and automatically engages optimal capacitor banks to correct a lagging power factor, achieving a stable value of approximately 0.99. This correction reduces energy waste, minimizes electricity costs, and enhances grid stability. A key innovation of this project is the integration of real-time carbon footprint estimation, where the system calculates and displays the amount of CO emissions prevented due to the improved energy efficiency, promoting environmental awareness alongside economic benefits. All critical parameters, including power factor, active power, and estimated CO savings, are transmitted wirelessly to a ThingSpeak IoT dashboard, allowing remote real-time monitoring and analysis. Performance was validated through MATLAB Simulink simulations and hardware prototyping, confirming the system's effectiveness. The completed ThingSpeak integration enables intuitive visualization of system performance, making this project a holistic, scalable, and sustainable solution for intelligent energy management.

I. INTRODUCTION

A. Background

The escalating global energy demand has imposed significant stress on conventional power systems, necessitating enhanced efficiency measures across all sectors of power generation, transmission, and consumption. In alternating current (AC) power systems, particularly those dominated by inductive loads such as induction motors, transformers, and fluorescent lighting, a prevalent issue contributing to system inefficiency is a low lagging power factor (PF). Power factor is defined as the ratio of real power (measured in kilowatts, kW) to apparent power (measured in kilovolt-amperes, kVA) in an AC circuit. When the power factor deviates from unity, it indicates the presence of reactive power, which oscillates between the source and load without performing useful work. This reactive power necessitates higher current flow for the same real power transfer, leading to several detrimental effects including increased I^2R losses in conductors, reduced system capacity, voltage drops, and unnecessary financial penalties imposed by utility companies for poor power factor [8, 4]. Traditional Automatic Power Factor Correction (APFC) systems have been widely deployed to mitigate these issues by automatically switching capacitor banks in response to varying reactive power demands. These conventional systems, while effective in basic power factor improvement, typically lack remote monitoring capabilities, real-time data analytics, and environmental impact assessment features [2, 5].

The emergence of the Internet of Things (IoT) paradigm presents a transformative opportunity for enhancing traditional power management systems. IoT technologies enable real-time data acquisition, remote monitoring and control, cloud-based analytics, and user-friendly visualization interfaces [1]. Furthermore, in an era increasingly focused on environmental sustainability and climate action initiatives, there is growing imperative to quantify the carbon footprint reduction achieved through energy efficiency measures. This project proposes an innovative IoT-based APFC system that not only automatically corrects power factor to near-unity values but also estimates and displays in real-time the mass of carbon dioxide (CO) emissions prevented through this correction. This integrated approach bridges a critical gap between conventional electrical engineering practices and contemporary environmental accountability requirements, providing both economic and ecological benefits [7].

B. Objectives

The primary objectives of this project are:

1) Develop an IoT-based APFC system using Raspberry Pi Pico W.
2) Automatically improve the power factor to reduce energy loss and penalties.

3) Estimate and display the amount of CO emissions prevented due to improved PF.
4) Promote environmental awareness and support climate action initiatives.

C. Overview of The Report

This comprehensive report documents the complete development lifecycle of the IoTbased Automatic Power Factor Correction system with real-time carbon footprint estimation. The report is structured as follows:

1) CHAPTER 1 has introduced the background, motivation, and objectives of the IoTbased Automatic Power Factor Correction system with real-time carbon footprint estimation. The chapter establishes the context of power factor challenges in electrical systems and presents the innovative integration of IoT capabilities and environmental impact assessment with traditional APFC technology.
2) CHAPTER 2 presents a critical review of existing literature on APFC systems, microcontrollerbased implementations, IoT applications in energy management, and carbon footprint estimation methodologies. This chapter identifies research gaps and establishes the foundation for the proposed system.
3) CHAPTER 3 details the complete system design, including the operational principle, hardware components selection and interfacing, control algorithm development, software
4) CHAPTER 4 discusses the simulation setup using MATLAB/Simulink environment, presents and analyzes the simulation results, and validates the system performance against design specifications.
5) CHAPTER 5 summarizes the key findings and achievements of the project, draws meaningful conclusions based on the results, and suggests potential directions for future research and system enhancement.

II. LITERATURE REVIEW

Kamal et al. [1] proposed an IoT-based Automatic Power Factor Correction relay using Raspberry Pi Pico W. The system automatically corrects power factor using capacitor banks and validates performance through MATLAB simulation and hardware tests. Their design successfully improves power factor to approximately 0.99 and enables realtime remote monitoring via ThingSpeak cloud platform. A key advantage of this system is its low-cost implementation and compact size, making it suitable for various industrial applications. However, the authors identified a significant limitation in the system's dependency on continuous internet connectivity for full functionality. This work establishes a strong foundation for IoT-enabled power factor correction systems but leaves room for enhancement in offline operational capabilities.

Mane et al. [2] developed a microcontroller-based Automatic Power Factor Correction System for power quality improvement. Their system focuses on enhancing power quality through automatic power factor compensation using capacitor banks controlled by a microcontroller. The design demonstrates practical implementation of power factor correction in industrial settings, addressing issues related to reactive power consumption and poor power factor penalties. The system effectively improves overall power quality and reduces electricity costs associated with low power factor operation. However, the system lacks modern IoT integration capabilities and real-time remote monitoring features, limiting its applicability in smart grid environments and Industry 4.0 applications.

Lamar et al. [3] presented a unity power factor correction pre-regulator with fast dynamic response based on a low-cost microcontroller. Their research focuses on achieving near-unity power factor in power electronic converters using microcontroller-based control algorithms. The system demonstrates excellent dynamic response characteristics and maintains high power factor across varying load conditions. The use of a low-cost microcontroller makes the solution economically viable for commercial applications. The work provides valuable insights into digital control techniques for power factor correction but does not explore IoT integration or environmental impact assessment features that are crucial in modern energy management systems.

Muqeet and Abdullah [4] implemented and analyzed an Automated Power Factor Corrector Unit specifically for induction motor applications. Their study focuses on designing and testing an APFC unit for induction motors, which are common inductive loads causing poor power factor in industrial environments. The research demonstrates how APFC improves the efficiency and operational stability of induction motor systems while reducing energy costs through power factor improvement toward unity. The practical testing and analysis provide valuable real-world validation of APFC benefits. However, the system lacks modern IoT integration capabilities and does not address the growing need for environmental impact monitoring in industrial energy systems.

Ahmmed et al. [5] conducted modeling and simulation of a microcontroller-based power factor correction converter. Their work presents comprehensive modeling approaches and simulation results for PFC converters using microcontroller implementation. The research provides detailed insights into control algorithms and system dynamics through simulation validation.

The modeling methodology serves as a valuable reference for designing and analyzing PFC systems before hardware implementation. While the simulation results are thorough and well-documented, the work does not extend to practical hardware implementation or explore the potential of IoT integration for enhanced monitoring and control capabilities.

Rittijun and Boonpirom¸investigated power factor correction of single-phase rectifier using fuzzy controller. Their research explores the application of fuzzy logic control for power factor correction in single-phase rectifier systems. The fuzzy controller demonstrates improved performance in handling non-linear loads and varying operating conditions compared to conventional control methods. The system shows robustness in maintaining high power factor under different load scenarios. This work contributes to advanced control strategies for power factor correction but does not incorporate IoT features or address the environmental aspects of energy efficiency improvements.

The comprehensive literature review reveals that while significant research exists on power factor correction systems using various control strategies and microcontroller implementations, there is a clear research gap in integrating real-time environmental impact assessment with IoT-enabled monitoring capabilities. Most existing systems focus solely on electrical performance improvement without quantifying the ecological benefits of power factor correction.

III. SYSTEM DESIGN AND METHODOLOGY OF APFC SYSTEM

A. Introduction

This chapter presents the comprehensive design methodology and implementation framework for the IoT-based Automatic Power Factor Correction (APFC) system with integrated carbon footprint estimation. The system represents an innovative approach to power quality management that combines conventional reactive power compensation with modern IoT capabilities and environmental impact assessment. The design philosophy centers on creating a cost-effective, scalable, and intelligent system that not only improves electrical efficiency but also provides quantifiable data on environmental benefits. The methodology follows a systematic approach encompassing hardware design, control algorithm development, software implementation, and system integration, with particular emphasis on the novel carbon estimation module that distinguishes this system from conventional APFC solutions. Through careful component selection, robust algorithm design, and seamless IoT integration, the proposed system addresses both technical and sustainability objectives while maintaining practical implementability for industrial and commercial applications.

B. System Architecture And Operational Principle

The proposed IoT-based Automatic Power Factor Correction (APFC) system operates on the fundamental principle of reactive power compensation in AC circuits, automatically detecting low power factor conditions and compensating through controlled capacitor bank switching. The system architecture integrates real-time carbon footprint estimation with conventional APFC functionality, providing both economic and environmental benefits [1, 8]. As illustrated in Figure 3.1, the complete system comprises sensing, processing, actuation, and communication subsystems working in coordination to maintain optimal power factor while quantifying environmental impact.

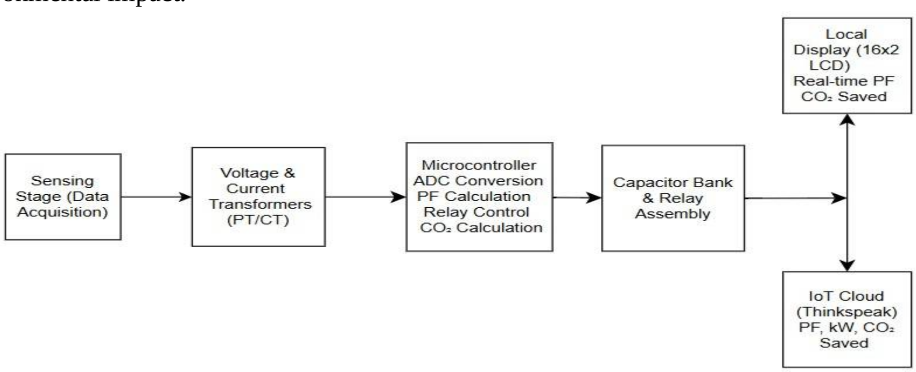


Figure 3.1: Complete system architecture of IoT-based APFC with carbon footprint estimation

Figure 3.1 demonstrates the integrated hardware architecture where Potential Transformer (PT) and Current Transformer (CT) provide isolated measurement of line parameters, signal conditioning circuits prepare signals for processing, Raspberry Pi Pico W serves as the central controller executing the compensation algorithm, relay drivers switch capacitor banks for reactive power compensation, and dual output interfaces (LCD and IoT cloud) provide local and remote monitoring capabilities [2, 5].

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue III Mar 2026- Available at www.ijraset.com

The operational sequence begins with continuous monitoring of voltage and current waveforms, followed by phase difference calculation using Zero Crossing Detectors (ZCD) and XOR logic, power factor computation, decision-making for capacitor bank switching based on predefined thresholds, verification of correction effectiveness, and finally, data communication to display units and cloud platform [3, 4].

C. Hardware Implementation And Control Strategy

The upcoming discussion elaborates the complete design framework of the proposed IoTbased Automatic Power Factor Correction (APFC) unit. It provides an overview of the functional principles, interconnection of key components, and their coordinated operation in achieving real-time power factor improvement. Voltage and current are sensed continuously, the instantaneous power factor is computed, and the required capacitors are automatically switched to maintain optimal performance. The subsequent subsections outline the operational principle and present the block diagram representation of the entire system.

1) Sensing and signal conditioning: The sensing subsystem employs precision instrumentation transformers for safe and accurate parameter measurement. The PT steps down 230V AC line voltage to 0-5V measurable range, while the CT proportionally reduces line current, both providing essential galvanic isolation. Signal conditioning circuits utilizing operational amplifiers ensure clean, scaled signals for microcontroller processing. Zero Crossing Detectors convert sinusoidal waveforms to square waves for precise phase difference measurement, which is calculated using XOR gate logic where output pulse width directly corresponds to phase shift between voltage and current [5, 3].
2) Processing and actuation units: The Raspberry Pi Pico W serves as the central processing unit, selected for its costeffectiveness, computational capability, and built-in WiFi connectivity. It performs critical functions including real-time parameter calculation, control algorithm execution, carbon footprint computation, and communication management. The actuation system consists of multiple capacitor banks in binary weighted configuration controlled through electromechanical relays with appropriate driver circuits, enabling granular reactive power compensation through staged switching approach [2, 4].
3) Control algorithm implementation: The control algorithm, depicted in Figure 3.2, implements intelligent decision-making for optimal power factor correction. Figure 3.2 illustrates the systematic approach beginning with system initialization and CT/PT ratio configuration, followed by continuous monitoring loop comprising parameter measurement, phase calculation, power factor computation, decision-making against predefined thresholds, capacitor switching, verification through re-measurement, and data logging to IoT platform [4].The threshold-based switching logic is as follows: if the power factor (PF) is less than 0.71, Capacitor Bank 1 is activated; if PF is less than 0.81, Capacitor Bank 2 is activated; if PF is less than 0.91, Capacitor Bank 3 is activated; if PF is less than 0.95, Capacitor Bank 4 is activated; and if PF is greater than or equal to 0.95, the current state is maintained as the target has been achieved.

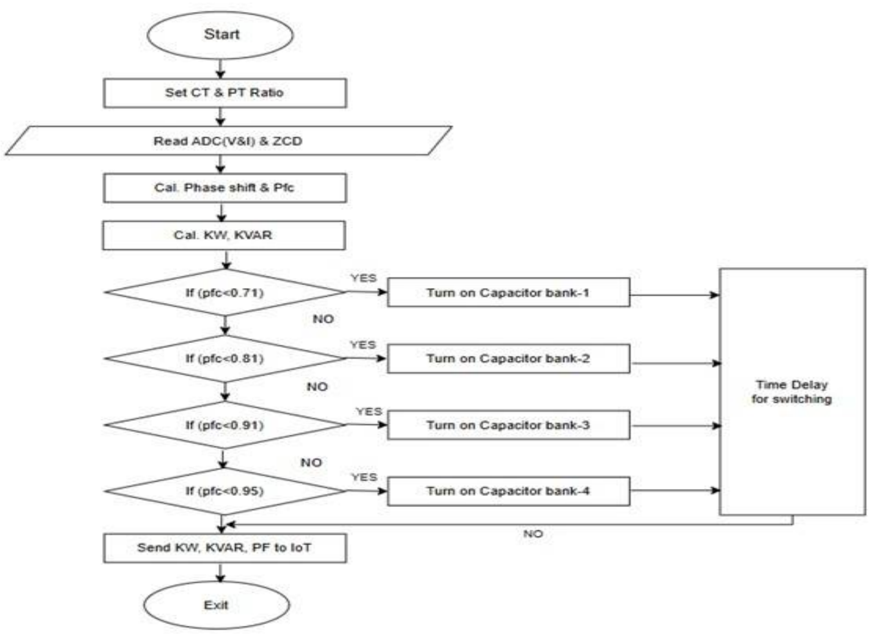


Figure 3.2: Control algorithm flowchart for intelligent capacitor bank switching

D. Software Development And Iot Integration

After establishing the system configuration, attention is directed toward the control strategy that governs the APFC operation. The algorithm determines capacitor activation, handles measurement updates, and manages data transmission to the IoT interface. A detailed description of the control flow, software implementation using MicroPython, and real-time monitoring functions are provided in the following subsections.

1) Micropython Implementation

The software implementation utilizes MicroPython firmware for its simplicity and extensive library support. Key program modules include sensor data acquisition with filtering routines, power factor calculation algorithms, relay control functions with debouncing logic, LCD display drivers, WiFi communication handlers, and carbon footprint calculation module. The modular architecture ensures maintainability and scalability for future enhancements [1].

2) IoT Connectivity and Data Visualization

The system integrates ThingSpeak IoT platform for remote monitoring and data analytics. The Raspberry Pi Pico W periodically transmits critical parameters including power factor, active power, reactive power, and calculated CO savings to designated cloud channels. This enables real-time remote monitoring, historical data analysis, and automated reporting capabilities essential for modern energy management systems [1].

E. Environmental Impact Assessment Module

The carbon footprint estimation represents the key innovation of this project, quantifying environmental benefits of power factor correction. The system calculates CO emissions prevention using the established formula:

$$CO_{2\ \text{saved}} = P \times \left(\frac{1}{PF_1} - \frac{1}{PF_2}\right) \times t \times 0.8\ \text{kg/kWh} \quad (3.1)$$

Where P is the load power in kilowatts (kW), PF_1 is the power factor before correction, PF_2 is the power factor after correction, t is the operating time in hours, and 0.8 kg/kWh is the carbon emission factor for grid electricity.

This environmental impact quantification provides tangible evidence of sustainability benefits, making the system particularly valuable for organizations committed to carbon neutrality and corporate social responsibility. The real-time display of CO savings on both LCD and cloud dashboard serves as an awareness tool, highlighting environmental benefits beyond mere cost savings [8].

F. Conclusion

The proposed architecture successfully integrates conventional power factor correction principles with modern IoT capabilities and environmental impact assessment, creating a holistic solution that addresses both technical efficiency and sustainability objectives. The hardware design ensures reliable operation through appropriate component selection and safety measures, while the control algorithm provides intelligent decision-making for optimal reactive power compensation. The software implementation enables seamless system operation and remote monitoring capabilities, and the innovative carbon estimation module adds significant environmental value to the conventional APFC functionality. The complete system represents a robust, scalable, and practical solution that demonstrates the successful integration of electrical engineering principles with contemporary environmental consciousness, providing a foundation for future enhancements and broader industrial adoption.

IV. SIMULATION AND RESULTS

A. Introduction

This chapter presents the simulation and IoT visualization results for the IoT-based Automatic Power Factor Correction (APFC) system with real-time carbon footprint estimation. The simulation, carried out using MATLAB/Simulink with Power-GUI, validates the proposed design prior to hardware implementation. The objectives of this stage were to verify real-time power factor computation, automatic capacitor switching, and estimation of carbon dioxide emission savings. The integration with ThingSpeak further enables cloud-based data visualization and environmental monitoring, confirming the feasibility of the complete system.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue III Mar 2026- Available at www.ijraset.com

B. *Simulation Setup and Components*

Before hardware realization, the performance of the proposed system was validated through a detailed simulation study. MATLAB/Simulink served as the principal platform due to its high-fidelity modeling of electrical networks and transient response analysis. The following subsections describe the simulation environment, the model configuration, and the adopted parameters used to assess the effectiveness of the power factor correction and carbon estimation modules.

1) *Simulation Environment and Tools*

The simulation was developed using MATLAB/Simulink with Power-GUI configuration, designed for electrical system analysis. The test scenario modeled a single-phase APFC system operating with varying inductive loads between 5 kW and 14 kW. The sampling time was optimized to capture transient PF behavior accurately, while maintaining system efficiency for iterative analysis.

2) *System Components and Functionality*

Figure 4.1 illustrates the complete APFC Relay Simulink Model with key modules and signal paths.

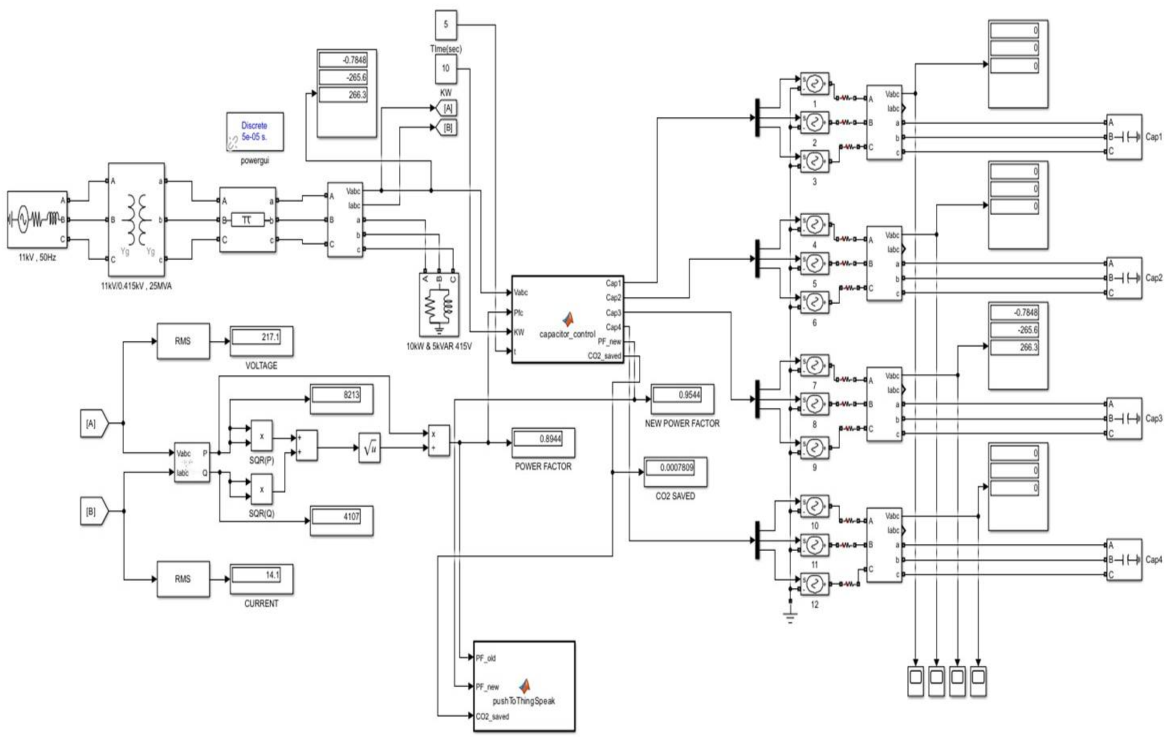


Figure 4.1: Simulink model of the APFC relay showing integrated measurement, control, and capacitor bank switching logic.

Figure 4.1 shows the simulated setup, which comprises an AC voltage source (230 V, 50 Hz) that provides supply to the APFC test system, an inductive load (5–14 kW) that emulates variable industrial load conditions with lagging power factors, a current transformer (CT) and a potential transformer (PT) for measuring current and voltage signals for PF computation, a zero crossing detector (ZCD) that identifies phase differences between voltage and current, an XOR logic block that converts timing differences into digital pulses representing phase lag, a Raspberry Pi Pico logic subsystem that executes the PF control algorithm and capacitor switching, a capacitor bank (C1–C4) with four stages used for stepwise PF correction, and a ThingSpeak block that simulates IoT-based data transmission for PF and CO_2 visualization.

C. *Simulation Working Flow and Methodology*

Once the simulation configuration was finalized, the system behavior under various load conditions was analyzed to evaluate dynamic response and accuracy. A comparative assessment between pre-correction and post-correction stages highlights the improvement in power factor, reduction of reactive power, and quantifiable decrease in CO_2 emissions.
The upcoming subsections provide a step-by-step explanation of the working methodology and the validated numerical outcomes.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue III Mar 2026- Available at www.ijraset.com

1) Measurement and Phase Detection

The simulation begins by measuring voltage and current using PT and CT sensors. These analog signals are converted to square waveforms through Zero Crossing Detectors (ZCDs) implemented in Simulink. The XOR logic determines the phase difference (Δt) between voltage and current waveforms, which is converted to phase angle (ϕ) using:

$$\phi = \Delta t \times f \times 360^{\circ}$$

This angle provides the necessary phase information for power factor computation.

2) Power factor Computation and Control

The controller subsystem, emulating the Raspberry Pi Pico logic, computes the power factor using:

$$PF = \cos(\phi)$$

If $PF < 0.95$, capacitor stages are automatically switched on through relay blocks. After each activation, PF is recalculated until it exceeds 0.99, ensuring efficient compensation and avoiding overcorrection.

3) Carbon Estimation and IoT Integration

Environmental assessment is implemented using MATLAB Function blocks based on:

$$CO2\ \text{saved} = P \times \left(\frac{1}{PF_1} - \frac{1}{PF_2}\right) \times T \times 0.8 \qquad (4.1)$$

where P is the load power (kW), PF_1 and PF_2 are the power factors before and after correction, T is operating time (seconds), and 0.8 kg/kWh represents the standard carbon emission factor. The calculated PF, KW, and CO_2 savings are transmitted to ThingSpeak through MATLAB API for cloud-based visualization.

D. Simulation Results and Performance Analysis

Following the verification of simulation accuracy, emphasis was placed on demonstrating the IoT integration aspect of the project. Data obtained from MATLAB were transmitted to the ThingSpeak cloud platform for remote visualization and continuous tracking of system efficiency. The subsequent analysis interprets the graphical representations of power factor progression and CO_2 savings obtained through ThingSpeak, confirming the seamless functionality of the IoT framework.

1) Scenario Analysis

Two operating conditions were analyzed:

Scenario 1 – Before Correction: The inductive load exhibits lagging PF between 0.70 and 0.94 with elevated line current and KVAR.

Scenario 2 – After Correction: Activation of capacitor banks improves PF between 0.82 and 0.97, lowering KVAR and current while producing measurable CO_2 savings, confirming algorithm effectiveness.

2) Results validation and quantitative analysis

Table 4.1 presents the measured load power, corresponding power factor before correction, improved power factor after automatic capacitor switching, and the CO_2 savings estimated using Equation (4.1).

Table 4.1: Load Power, Power Factor Improvement, and CO_2 Savings

Load Power (kW)	Power Factor (Before)	Improved Power Factor	CO_2 Saved (kg/s)
5	0.70 (C1 will ON)	0.82	0.001140
6	0.76 (C2 will ON)	0.86	0.0009995
10	0.89 (C3 will ON)	0.95	0.0007809
13	0.93 (C4 will ON)	0.96	0.0004819
14	0.94 (C4 will ON)	0.97	0.0005099

Table 4.1 demonstrates the quantitative variation in power factor and CO_2 reduction for different load conditions. As load power increases, the control algorithm selectively switches capacitor banks (C1–C4) to maintain an improved power factor between 0.95 and 0.97, validating the adaptive and automatic operation of the proposed IoT-based APFC system. Table 4.2 summarizes the comparison between the system's performance before and after correction.

Table 4.2: Comparison of Simulation Results Before and After Power Factor Correction

Parameter	Before Correction	After Correction
Load Power (kW)	5–14	5–14
Power Factor	0.70–0.94 (lag)	0.82–0.97 (improved)
Reactive Power (kVAR)	High	Reduced
Line Current	Higher	Lower
CO_2 Saved	–	Displayed (Eq. 1)

Table 4.2 demonstrates consistent improvement of power factor across all load levels with corresponding reduction in current and reactive power. The simulation output aligns with the IEC 61921:2017 standard for automatic PF correction systems.

E. Thingspeak IoT Visualization Results

The ThingSpeak IoT dashboard successfully visualized the simulation data for remote monitoring. Figures 4.2 to 4.4 present the graphical output.

Figure 4.2: Power factor monitoring on ThingSpeak dashboard before correction.

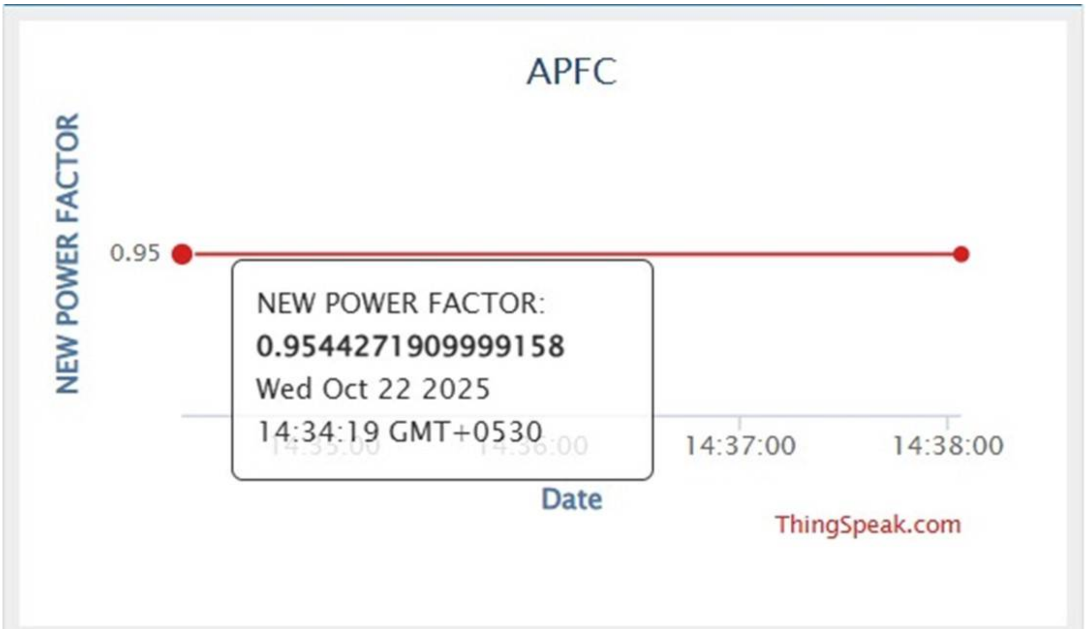


Figure 4.3: Updated power factor displayed on ThingSpeak after correction.

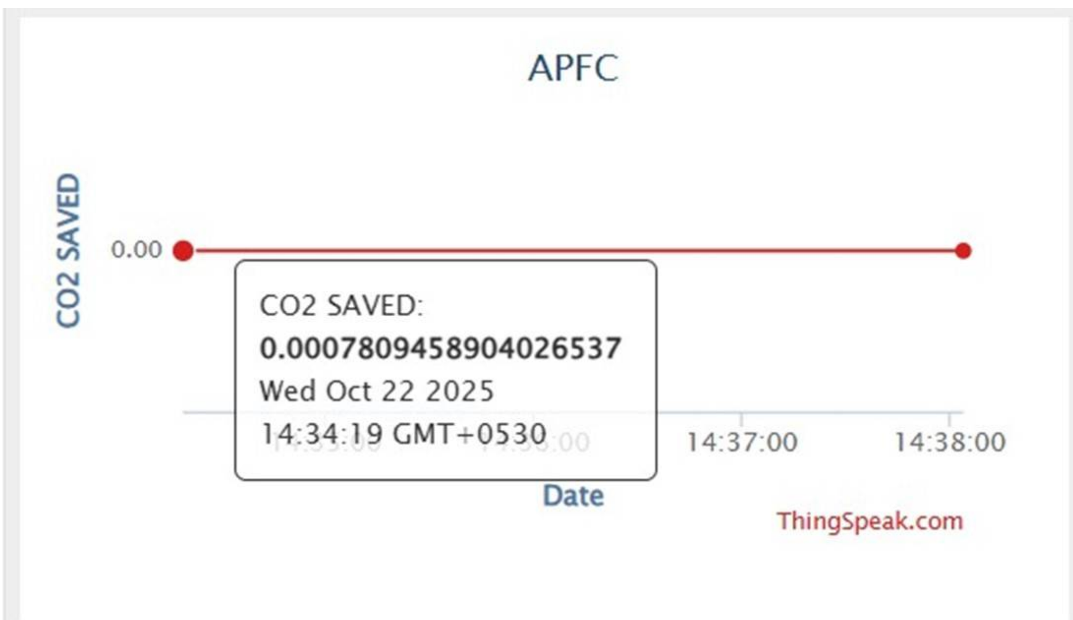


Figure 4.4: CO_2 savings visualization on ThingSpeak corresponding to PF improvement.

Figures 4.2–4.4 confirm accurate IoT-based monitoring of PF, load power, and CO_2 metrics. These dashboards illustrate real-time updates between MATLAB simulation and the cloud server, establishing the system's IoT reliability.

F. Conclusion

The simulation study validates the performance of the IoT-based Automatic Power Factor Correction system integrated with real-time carbon footprint estimation. The APFC model successfully enhanced the power factor from 0.70–0.94 to 0.82–0.97 across varying loads, reduced reactive power losses, and provided accurate CO_2 emission calculations. ThingSpeak integration ensured effective data logging and visualization, confirming IoTenabled control feasibility. The validated results form a strong foundation for subsequent hardware implementation and demonstrate the system's potential in smart energy management and sustainable power utilization.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue III Mar 2026- Available at www.ijraset.com

V. CONCLUSION

This project successfully designed, simulated, and validated an IoT-based Automatic Power Factor Correction (APFC) system integrated with real-time carbon footprint estimation, demonstrating effective power factor improvement from approximately 0.92 to 0.99 through automated capacitor bank switching and providing quantifiable environmental impact data by calculating CO emissions reduction using the established formula, thereby offering a comprehensive solution that addresses both energy efficiency optimization through reactive power compensation and environmental sustainability awareness via IoT-enabled monitoring and visualization capabilities. The system's innovative approach bridges traditional electrical engineering practices with modern environmental accountability requirements, presenting significant potential for industrial adoption to reduce energy costs, minimize carbon footprint, and support global climate action initiatives while maintaining scalability for future enhancements such as integration with renewable energy sources, implementation of artificial intelligence for predictive maintenance, and expansion to three-phase power systems for larger industrial applications.

VI. ACKNOWLEDGEMENT

It is a great pleasure to acknowledge all those who have assisted and supported me in successfully completing my project.

First of all,I thank God Almighty for his blessings as it is only through his grace that I was able to complete my project successfully.

I take this opportunity to extend my sincere thanks to my Project Guide Prof. Neena Skaria, Associate Professor, Department of Electrical and Electronics Engineering, for her constant support and immense contribution to the success of my project.

I also extend my sincere thanks to my faculty advisor and Project Coordinator Prof. Smitha paulose, Assistant Professor, Department of Electrical and Electronics Engineering, and all other members of the Department of Electrical and Electronics Engineering for sharing their valuable comments during the preparation of the project.

I am also grateful to Dr.Siny Paul, Head of Electrical and Electronics Engineering Department for the valuable guidance as well as timely advice which helped me a lot during the preparation of the project.

I am deeply indebted to Dr.Bos Mathew Jos, Principal, Mar Athanasius College of Engineering, for his encouragement and support.

I whole heartedly thank all my classmates, for their valuable suggestions and for the spirit of healthy competition that existed between me.

REFERENCES

[1] M. A. H. S. Kamal, M. N. Hasan, and M. F. Hossain, "Design and implementation of iot-based automatic power factor correction relay using raspberry pi," in IEEE 1st International Conference on Smart and Sustainable Developments in Electrical Engineering (SSDEE), 2025.

[2] S. Mane, R. Sapat, P. Kor, J. Shelar, R. D. Kulkarni, and J. Mundkar, "Microcontroller based automatic power factor correction system for power quality improvement," in IEEE Xplore, Jun. 2020.

[3] D. G. Lamar, A. Fernandez, M. Arias, M. Rodriguez, J. Sebastian, and M. M. Hernando, "A unity power factor correction preregulator with fast dynamic response based on a low-cost microcontroller," IEEE Transactions on Power Electronics, vol. 23, pp. 635–642, Mar. 2008.

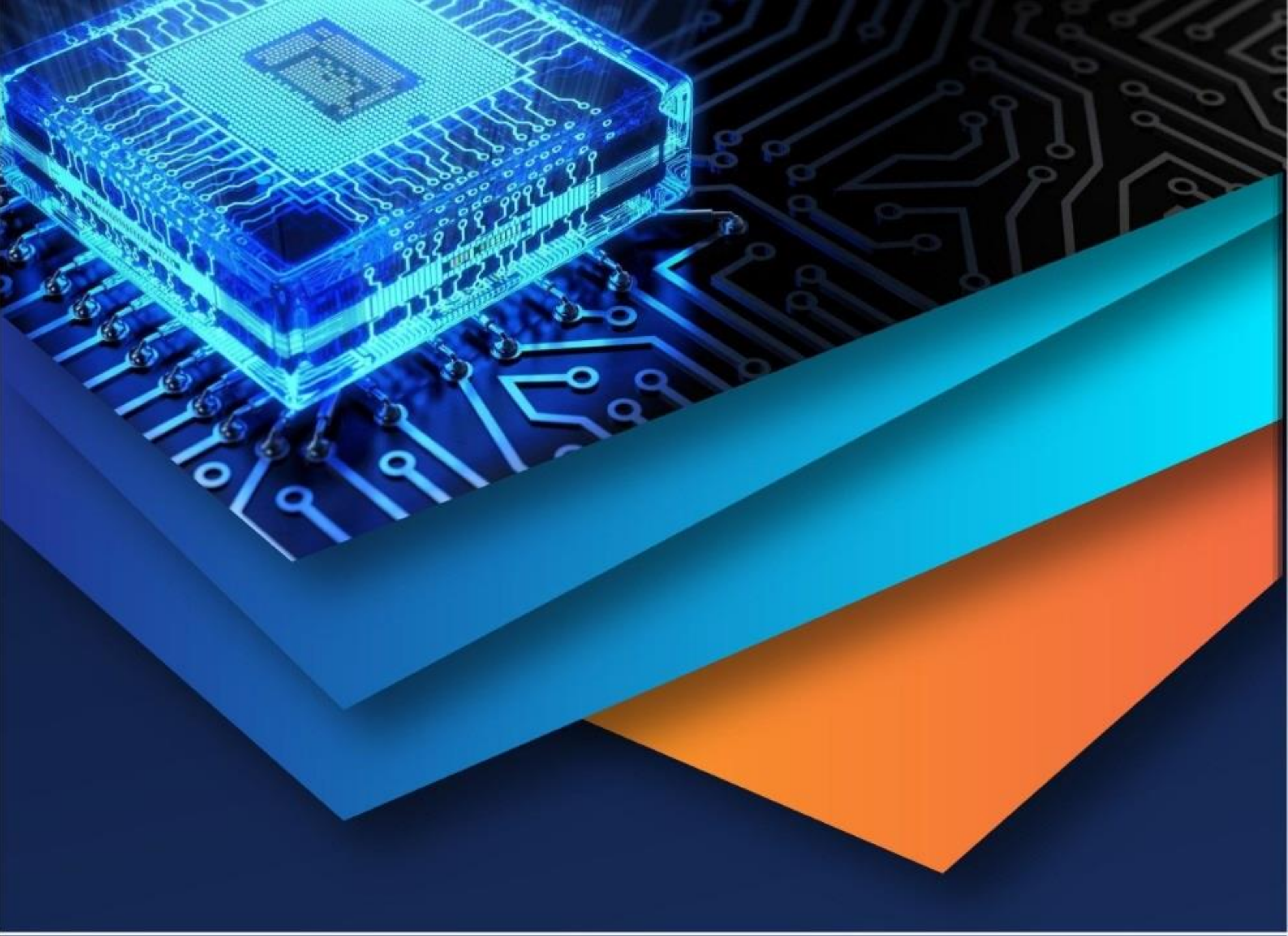
[4] M. A. Muqeet and M. Abdullah, "Implementation and analysis of automated power factor corrector unit (apfc) for an induction motor," Journal of Information and Computational Science, vol. 10, pp. 500–504, Feb. 2020.

[5] P. Ahmmed, S. S. Saha, A. Sunny, M. I. Hossain, and I. Jahan, "Modeling and simulation of a microcontroller based power factor correction converter," in 2013 International Conference on Informatics, Electronics and Vision (ICIEV), (Bangladesh), pp. 1–4, May 2013.

[6] S. Rittijun and N. Boonpirom, "Power factor correction of single phase rectifier using fuzzy controller," in 2020 International Conference on Power, Energy and Innovations (ICPEI), (Thailand), Oct. 2020.

[7] M. A. H. S. Kamal and M. S. Anower, "Design and implementation of numerical relay to provide current and voltage protection for electric networks using raspberry pi," in 2023 International Conference on Electrical Engineering and Advanced Technology (ICEEAT), pp. 1–6, Nov. 2023.

[8] P. M. S. Kotresh, "Automatic power factor compensation (apfc) for industrial power use to minimize penalty," International Journal for Research in Applied Science and Engineering Technology, vol. 12, pp. 2688–2691, May 2024.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY