

Automatic Power Supply Control from Multiple Sources Using Microcontroller

Namburi Nireekshana¹, Pingili Sowjanya², Bukhya Sathish³, Mohammad Farhan⁴

¹Assistant Professor, Dept. of EEE, Methodist College of Engineering and Technology, Hyderabad
^{2,3,4}B.E IV year, Dept. of EEE, Methodist College of Engineering and Technology, Hyderabad

ABSTARCT

Objective: The primary aim of this project is to develop an Automated power supply control system that ensures uninterrupted electricity delivery to critical loads, such as those in hospitals, data centers, and industrial facilities, by intelligently selecting and switching among four distinct power sources: mains AC supply, inverter/battery, generator, and solar panel. This addresses the challenge of frequent power outages in regions with unreliable grid infrastructure, minimizing downtime and operational disruptions. **Novelty:** Unlike conventional Automatic Transfer Switches (ATS) that rely on bulky magnetic contactors or mechanical timers, which are prone to wear, high failure rates, and elevated costs, this system employs a PIC microcontroller for precise digital logic control. It introduces programmable priority sequencing, real-time status monitoring via an LCD display, and relay-based switching that reduces power losses and enhances reliability, making it a compact, affordable alternative suitable for both residential and commercial applications. **Methodology:** The system architecture centers on a PIC microcontroller interfaced with four input sensing switches (one per source) to detect voltage presence or failures. Upon mains failure, the PIC scans subsequent priorities sequentially: it activates Transistor-driven relays to connect the next available source to the load. An LCD module displays the active source and system status. Hardware testing involved simulating outages with toggle switches and verifying seamless transfer using a lamp as the dummy load. **Findings:** Achieves seamless failover, ensuring no power interruption; demonstrated with a lamp load.

Keywords: PIC microcontroller, No Power Interruption, Automated power supply, Relays, LCD display.

1. Introduction

Automatic power-source control is essential in modern life, where continuous and reliable electricity is required for homes, hospitals, data centers, and industries. However, frequent grid failures, voltage fluctuations, and limitations of fuel-based generators make uninterrupted power supply difficult. To overcome these issues, systems have been developed that automatically select and switch between multiple sources such as mains AC, diesel generators, solar PV, wind energy, and inverter or battery backups. A microcontroller-based automatic power-supply control system continuously monitors the availability of these sources, detects their presence or absence, and shifts the load to the next available source without manual intervention, thereby minimizing downtime and improving reliability[1], [2].

The microcontroller acts as the brain of the system by sampling the status of each power source through voltage-sensing circuits or switches and executing a pre-programmed priority logic. Typically, mains power is given the highest priority, followed by solar, inverter or battery, and finally the generator. Whenever a higher-priority source becomes available again, the system automatically switches back to it. This logic can be easily implemented using C or embedded C programming on commonly used microcontrollers such as PIC, 8051, or AVR, making the system flexible, efficient, and reprogrammable according to requirements[3], [4].

A typical automatic power-supply control system consists of four main components: a sensing stage, a microcontroller unit, relay drivers with relays, and a display or indication module. The sensing circuits convert the presence or absence of voltage from each source into digital signals that can be read by the microcontroller. Based on this input, the microcontroller sends control signals to relay driver ICs like ULN2003, which activate the appropriate relays to connect the selected power source to the load. Display units such as LCDs or LEDs provide real-time information about which source is currently active, aiding in monitoring and maintenance[5], [6].

Conventional systems often rely on manual or electromechanical switching methods, which are slow, prone to human error, and incapable of handling complex priority logic. They also lack real-time monitoring, which can lead to undetected faults such as overvoltage, under voltage, or source failure, potentially causing equipment damage. Additionally, these traditional systems do not effectively utilize renewable energy sources, leading to increased dependence on generators, higher operational costs, and greater environmental impact, especially in rural or unstable grid areas[6], [7].

Another major challenge in such systems is maintaining power quality and reliability. Issues like voltage sags, swells, harmonics, and transient spikes can occur during switching. If the changeover is not smooth, sensitive equipment such as computers and medical devices may get damaged or reset. Some systems also suffer from slower response times, and improper synchronization between sources like mains and generators can lead to serious faults such as short circuits or circulating currents[8], [9], [10].

The integration of renewable and non-renewable energy sources is a key advantage of modern automatic control systems. Renewable sources like solar and wind are environmentally friendly but intermittent, whereas mains and generators provide stability but at higher cost or fuel dependency. A microcontroller-based system can intelligently prioritize renewable energy, use battery backup when needed, and rely on generators only during extended outages, thereby optimizing energy usage and reducing emissions. It also enables smart load management by separating critical and non-critical loads[11], [12].

Microcontrollers offer several advantages, including compact size, low cost, ease of interfacing, and flexibility. Their programmable nature allows easy updates to system logic without hardware changes. Many microcontrollers also include built-in features such as analog-to-digital converters, communication interfaces, and timers, enabling advanced functionalities like real-time monitoring, data logging, and remote communication[13], [14].

By automating the switching process, these systems significantly reduce human intervention and improve reliability. They can respond quickly to power failures, ensuring continuous supply to critical loads. Features like automatic return to mains, delay mechanisms, and interlocking prevent unsafe operations.

Additional monitoring and alert systems such as buzzers, SMS notifications, or SCADA integration further enhance system performance[15], [16].

Furthermore, automatic power-supply control improves energy efficiency and reduces costs by prioritizing renewable sources and minimizing generator usage. This leads to lower fuel consumption, reduced maintenance, and decreased environmental pollution. It supports sustainable energy practices and helps in achieving environmental goals[17], [18].

In the future, these systems can be further enhanced with smart-grid integration, including features like Maximum Power Point Tracking (MPPT), battery state monitoring, and load-shedding strategies. Integration with IoT and SCADA systems will enable remote monitoring and predictive maintenance. Advanced algorithms and machine learning techniques can also be implemented to dynamically optimize power usage and improve overall system efficiency[19],[20].

2.Methodology

Automatic power supply control from multiple sources uses a microcontroller to continuously monitor the availability of different power sources such as mains, solar, inverter, and generator, and automatically switches between them to ensure uninterrupted power supply for critical loads during outages. The system consists of several core components, including a microcontroller such as PIC16F877A or 8051, which reads inputs from voltage sensors or switches that simulate source availability. The sensing circuit typically includes voltage dividers, bridge rectifiers, and Zener diodes that detect the presence of voltage within a range (around 160–220V) and convert it into a safe 0–5V signal suitable for the microcontroller input pins. Relays, driven by driver ICs like ULN2003 or transistors, are used to switch between power sources, while contactors handle high-load applications such as 3-phase systems. A 16×2 LCD and LEDs are used to display and indicate the currently active source, and a regulated 5V power supply using a 7805 voltage regulator along with a crystal oscillator (4–8 MHz) powers the microcontroller.

The sensing mechanism works by passing each source voltage through a bridge rectifier, followed by a voltage divider and Zener diode to produce a stable DC signal that the microcontroller can read through its input pins (such as RA0–RA3). Based on these inputs, the microcontroller applies a predefined priority logic, typically giving preference in the order of mains, solar, inverter, and then generator. The switching logic ensures that the highest-priority available source is always selected. When the primary source (mains) fails, the microcontroller activates the next available source by sending signals through output pins (such as RC0–RC3) to the relay driver, which in turn energizes the appropriate relay. Only one relay is activated at a time to prevent overlapping of sources, ensuring a smooth and seamless transfer without noticeable interruption.

The programming flow involves initializing the microcontroller, LCD, and input/output ports, followed by a continuous loop where the system reads the status of all sources, checks the priority sequence, activates the corresponding relay, and updates the display with the active source status (e.g., “Mains Active”). The control logic is typically implemented using Embedded C in environments such as MPLAB or CCS, using simple if-else conditions. Overall, the system can be represented by a block diagram consisting of sources connected to sensing circuits, feeding into the microcontroller, which controls relay drivers and relays to supply power to the load, with an LCD providing real-time feedback.

2.1 Block Diagram

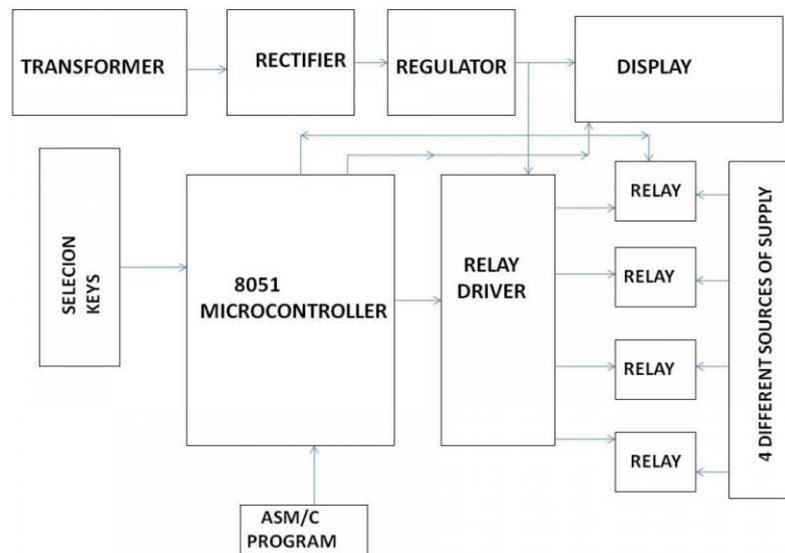


Figure 1. Block Diagram

Microcontroller: In this auto power supply control system, the microcontroller is used for the auto selection of the available source. It shifts the load to the other power supply source automatically without any interruption.

Relay Driver: In this auto power supply control system, the relay driver is used for driving the load relays. This relay receives the signal from microcontroller for shifting the load on another supply source.

Transformer: The transformer is used for connecting this system directly to 220V AC. It steps down 220V into 12V.

Voltage Regulator: The voltage regulator is used for regulating 12V DC into 5V DC voltages for supplying the power to the LED, microcontroller and other components.

LCD Display: LCD display is used for displaying the source of supply on which the whole system is working.

Push Buttons/Switches (4x): Simulate source failures as inputs to microcontroller.

Rectifier: In an automatic power supply control system using a microcontroller, the rectifier converts alternating current (AC) from sources like the mains or generators into direct current (DC). It works with a transformer and regulator to provide a stable, low-voltage DC (e.g., 5V) essential for powering the microcontroller and relay driver circuitry.

2.2 Working principle:

The Automatic Power Supply Control from Different Sources using Microcontroller—a practical system for switching power sources (solar, mains, battery) automatically based on availability. It ensures

uninterrupted supply to a load (bulb) using priority logic, common in renewable energy and UPS projects. The microcontroller monitors voltages and controls relays to select the best source.

Components and Their Functions:

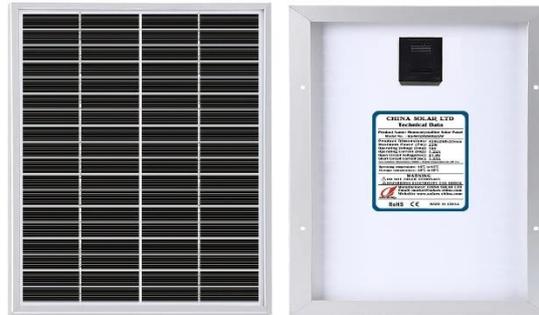


Figure 2. Solar Panel

Captures sunlight to generate DC power. Voltage/current fed to a charge controller or directly monitored by the microcontroller. Primary/priority source in daytime; enables eco-friendly power when sufficient.



Figure 3. DC-DC Buck Converter/Regulator

Steps down high DC voltage (e.g., from solar ~18-20V) to stable 5V/12V for microcontroller and logic circuits. Prevents overvoltage damage and ensures consistent supply.



Figure 4. Microcontroller Board

Brain of the system. Monitors input voltages from sources via ADC pins, decides priority (e.g., solar > mains > battery), and sends signals to relays. Runs code to check thresholds (e.g., if solar > 12V, activate it).



Figure 5. Relay Module

Electromechanical switches controlled by microcontroller GPIO pins. Each handles one source: one for solar DC to load, one for battery, one for mains AC via rectifier. Automatically connects/disconnects sources to avoid conflicts.

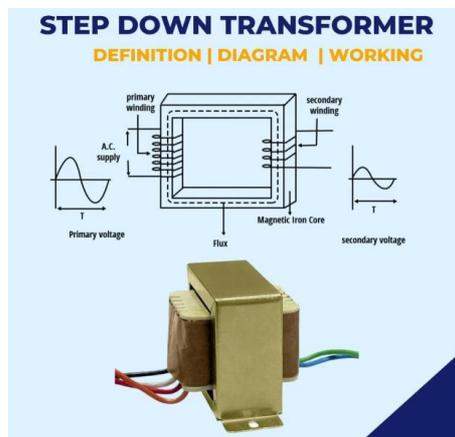


Figure 6. Step-Down Transformer

Steps down mains AC voltage (e.g., 230V to 12V AC) for rectification to DC. Used for mains source input; paired with bridge rectifier (nearby) to convert to DC comparable with solar/battery.

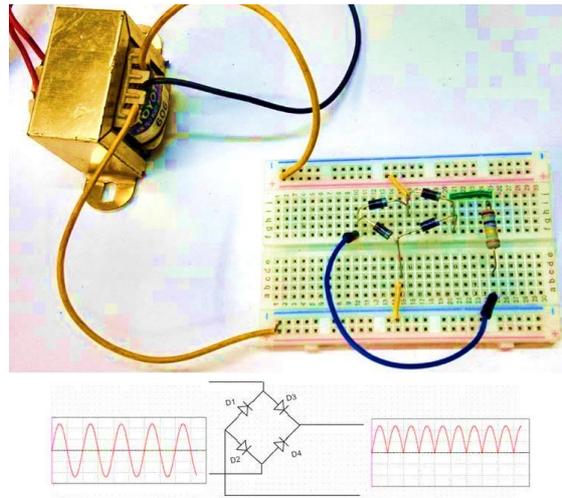


Figure 7. Bridge Rectifier

Converts AC from transformer to pulsating DC. Smoothened by capacitors (not clearly visible) for mains source, making it compatible with DC sources like solar/battery.



Figure 8. Battery

Stores excess solar energy or acts as backup. Connected via relay; microcontroller switches to it when solar/mains fail (e.g., low voltage detection).



Figure 9. Load Indicator

Represents the actual appliance/load (e.g., 12V DC lamp). Powered by the selected source via common relay output, demonstrating seamless switching.



Figure 10. LCD Display

It provides visual status updates on source availability, identifies the active source (e.g., Main, Solar, Generator, Inverter), and monitors voltage levels to ensure seamless, automated switching.

Automatic power supply control systems using microcontrollers ensure uninterrupted power by intelligently switching between multiple sources such as mains, generator, inverter, solar, or battery. These systems are especially important in critical applications like hospitals, data centers, and industrial environments where even a short power interruption can cause serious disruptions. The core principle of operation involves continuous monitoring of voltage levels from each source through voltage sensors or divider circuits connected to the microcontroller's input pins. When the primary source, usually mains, drops below a predefined threshold, the microcontroller quickly detects the condition and initiates switching by activating the appropriate relay to connect the next available power source.

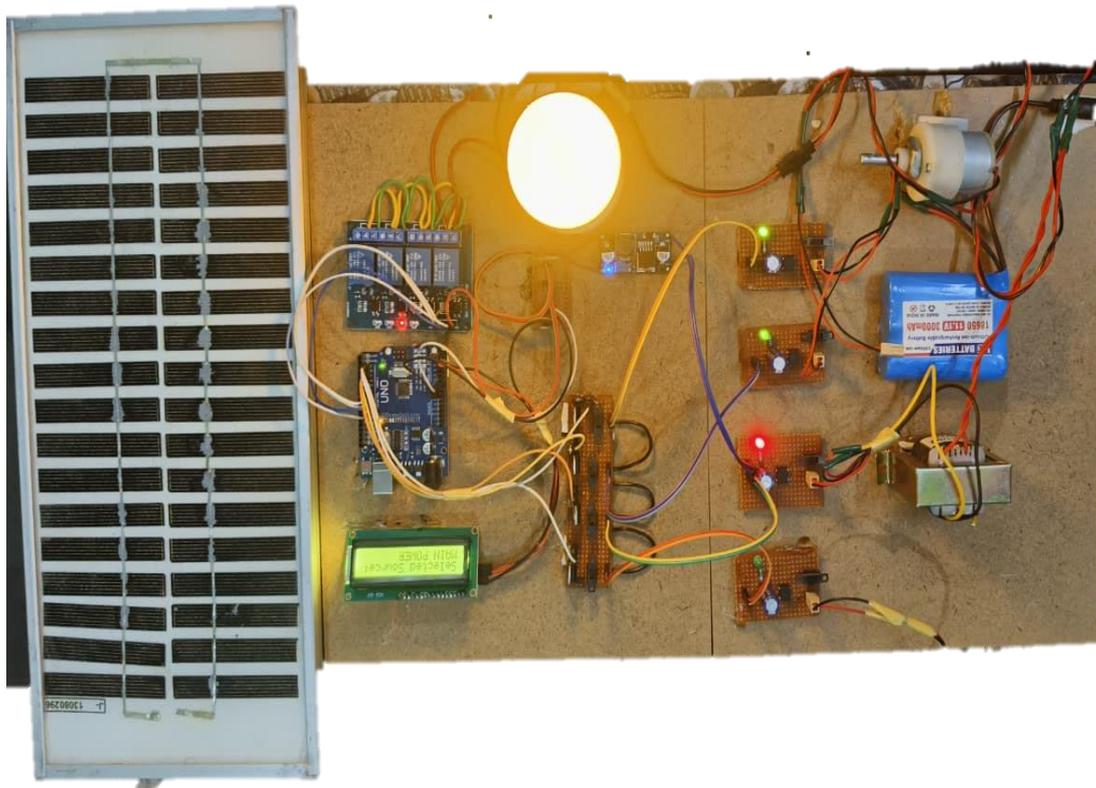


Figure 11. Circuit Diagram

The system consists of several key components working together. The microcontroller, such as PIC, 8051, or ESP32, acts as the central controller and executes a priority-based algorithm that determines the order of source selection, typically following mains, inverter, generator, and then solar. Voltage sensors or step-down transformers are used to reduce and rectify AC voltage into a safe DC level suitable for the microcontroller, while capacitors help in filtering noise for stable readings. Relay driver circuits like ULN2003 amplify the low-power signals from the microcontroller to drive electromechanical relays, which are used to switch and isolate power sources safely. A display unit such as an LCD provides real-time information about the active power source, and a regulated power supply using a 7805 IC ensures a stable 5V supply to the microcontroller.

During operation, the system initializes with the highest priority given to mains supply. The sensors continuously provide real-time voltage status to the microcontroller, where a valid signal indicates source availability. If the mains supply fails, the microcontroller deactivates its corresponding relay and immediately activates the next available source, such as the inverter, ensuring a smooth transfer of load. This process continues automatically for all subsequent failures, maintaining uninterrupted supply. The

entire logic is implemented using embedded C programming, allowing flexibility to adjust priority levels, switching delays, and system behaviour based on requirements.

Operational Logic: Priority Management

In most systems, sources are ranked by cost and availability. A standard priority list looks like this:

- ❖ Solar (Priority 1): Free and renewable.
- ❖ Mains/Grid (Priority 2): Reliable but costs money.
- ❖ Generator (Priority 3): Expensive (fuel) and noisy.
- ❖ Battery (Priority 4): Reserved for total emergencies.

Scenario A: When All Sources are Available

- ❖ When the MCU detects that all power sources are active, it follows the Priority Logic programmed into its firmware.
- ❖ Scanning Phase: The MCU constantly polls the input pins connected to the sensing circuits.
- ❖ Decision Phase: Even though the Grid and Generator are "ON," the MCU identifies that Solar (Priority 1) is available.

Execution Phase:

- ❖ The MCU sends a signal to the Relay Driver.
- ❖ The Relay for the Solar source is energized (Closed).
- ❖ The Relays for Grid and Generator remain de-energized (Open).
- ❖ Result: The load runs on Solar power. This maximizes cost savings.

Scenario B: When Only One Source is Available

- ❖ When only one source is detected, the system enters a Conditional Loop to ensure the load remains active regardless of priority.
- ❖ Failure Detection: If the Solar (Priority 1) drops out (e.g., at night), the MCU detects a "Low" signal on that sensing pin.
- ❖ Search Phase: The MCU immediately checks the status of Priority 2 (Mains). If Mains is also down, it moves to Priority 3 (Generator).
- ❖ The "Last Stand" Logic:

- ❖ If only the Generator is available, the MCU recognizes this as the only viable path.
- ❖ It triggers the Generator Relay while keeping all other relays open to prevent back-feeding (power flowing back into a dead grid).
- ❖ Safety Interlock: The software ensures a "Break-Before-Make" delay (usually milliseconds) so that two sources never touch each other, which would cause a short circuit.

Step-by-Step Process Flow

- ❖ Step 1 (Sensing): Step-down transformers or voltage dividers reduce high AC/DC voltages to 5V DC for the MCU to read safely.
- ❖ Step 2 (Processing): The MCU runs a continuous loop comparing input states against the priority hierarchy.
- ❖ Step 3 (Switching): If a higher priority source fails, the MCU identifies the next best source and toggles the corresponding relay via a transistor (like the ULN2003 driver).
- ❖ Step 4 (Feedback): The system updates the LCD (e.g., "Source: Generator") and continues monitoring. If the Priority 1 source returns, the system automatically switches back.

2.3 Applications

- ❖ Hospitals and medical facilities to power life-support systems and OT equipment during outages.
- ❖ Data centers and IT servers to prevent costly downtime exceeding \$5,000 per minute.
- ❖ Industrial plants for CNC machines, conveyors, and control panels to avoid production halts.
- ❖ Telecom towers and base stations ensuring continuous network connectivity.
- ❖ Educational institutions, banks, and offices in power-unstable regions like rural India.
- ❖ Remote sites such as oil rigs, agricultural pumps, and construction areas for off-grid reliability.
- ❖ Smart homes and residential setups integrating solar and UPS for daily appliances.
- ❖ EV charging stations and transportation electrification projects for stable supply.

2.4 Advantages

- ❖ Ultra-fast switching under 20ms for zero-interruption power transfer.
- ❖ Programmable priority logic (mains > inverter > generator) via Embedded C on PIC/8051/ESP32.
- ❖ Cost-effective at ₹1500-2000 using relays, ULN2003, and basic sensors.

- ❖ Energy savings by auto-disabling idle sources, reducing generator fuel by 25-30%.
- ❖ Real-time LCD monitoring of active source and voltage status.
- ❖ Fault detection with overload protection and watchdog timers for MCU reliability.
- ❖ Scalable for renewables with MPPT solar integration and smart grid compatibility.
- ❖ Reduced maintenance over electromechanical switches; no wear from arcing.
- ❖ IoT-ready with ESP32 Wi-Fi for remote alerts and mobile app control.
- ❖ Enhanced safety via isolated relays and automatic low-voltage cutoffs.

3. Conclusion

Automatic power supply control systems using microcontrollers provide a reliable and efficient solution for ensuring uninterrupted electricity in modern applications. These systems automatically switch between multiple power sources such as mains AC, inverter (UPS), generator, solar panels, and batteries, effectively addressing the issue of power outages that are still common in regions like rural areas and industrial environments. By continuously monitoring the availability of each source, the microcontroller ensures seamless transfer of power, thereby maintaining continuity of supply for critical loads. One of the major advantages of these systems is their ability to perform ultra-fast switching, typically within 20 milliseconds, which prevents disruptions in sensitive equipment like computers and medical devices. The system operates based on a priority algorithm programmed in Embedded C on microcontrollers such as PIC16F877A or 8051, where sources are selected in a predefined order to optimize both cost and energy utilization. Energy efficiency is further improved by automatically disconnecting unused sources, which can reduce generator fuel consumption significantly. User-friendly features such as LCD displays and buzzers help in monitoring system status, while advanced versions support IoT integration using controllers like ESP32 for remote alerts and control. Additionally, these systems are cost-effective, with basic implementations requiring relatively low-cost components such as relays and ULN2003 drivers. Despite these advantages, certain limitations exist. Relay switching can cause arcing, which can be minimized using snubber circuits, and the system may face single-point failure if the microcontroller malfunctions, which can be addressed by using watchdog timers. Future improvements can include advanced techniques such as Maximum Power Point Tracking (MPPT) for better solar energy utilization and the use of machine learning algorithms for intelligent load forecasting and optimization. In practical applications, this technology plays an important role in modern power systems by supporting smart grid development, improving energy reliability, and enabling better integration of renewable energy sources. It is also highly valuable as an educational project, offering hands-on experience in embedded systems, power electronics, and control systems. Overall, microcontroller-based automatic power supply systems enhance reliability, reduce operational costs, and contribute to sustainable and efficient energy management.

4. Future scope

The future scope of automatic power supply control systems using microcontrollers is highly promising, as these systems are evolving from simple source-switching mechanisms into intelligent and sustainable power management solutions. With rapid advancements in embedded systems, IoT, and renewable energy technologies, such systems are expected to play a major role in transforming global energy management. One of the key future enhancements is IoT integration, where controllers like ESP32 with Wi-Fi enable real-time cloud monitoring, remote control, and predictive alerts. Artificial intelligence and machine learning techniques can be incorporated to forecast power outages using historical data and weather information, allowing proactive decision-making. Solar systems can be further optimized using Maximum Power Point Tracking (MPPT) to maximize energy harvesting from renewable sources.

Emerging technologies such as blockchain can enable peer-to-peer energy trading in micro-grids, allowing users to sell excess solar power efficiently. Edge computing can provide faster, decentralized decision-making by processing data locally without cloud dependency, while 5G connectivity can support ultra-low latency switching required in advanced applications like electric vehicle fast-charging stations. Integration with voice assistants such as Alexa or Google Home can allow hands-free control of power sources, enhancing user convenience. Improved energy storage synchronization using advanced batteries like LiFePO₄ and super capacitors will ensure better backup performance and longer life.

Future systems will also incorporate grid synchronization techniques such as phase-locked loops to safely match generator or inverter output with the mains supply. Advanced fault prediction methods using vibration or acoustic sensors can help detect failures in relays or generators before they occur. Mobile applications will provide user-friendly dashboards for monitoring energy consumption and manual control, while strong cyber security measures such as encryption and anomaly detection will protect the system from potential threats. Vehicle-to-Grid (V2G) technology will allow electric vehicles to act as backup power sources, further enhancing flexibility.

References

1. N. Nireekshana, A. Archana, and K. Pullareddy, "A Classical H6 Topology for Modern PV Inverter Design," in *Power Energy and Secure Smart Technologies*, CRC Press, 2025, pp. 1–7. Accessed: Nov. 12, 2025. [Online]. Available: <https://www.taylorfrancis.com/chapters/edit/10.1201/9781003661917-1/classical-h6-topology-modern-pv-inverter-design-namburi-nireekshana-archana-pullareddy-kanth-rajini>
2. C. P. Prasad and N. Nireekshan, "A Higher Voltage Multilevel Inverter with Reduced Switches for Industrial Drive," *Int. J. Sci. Eng. Technol. Res. IJSETR*, vol. 5, no. 1, 2016, Accessed: Nov. 12, 2025. [Online]. Available: https://methodist.edu.in/web/uploads/naac/2019-11-19%2012_24_22pm%2092.pdf
3. N. Namburi Nireekshana and K. R. Kumar, "A Modern Distribution Power Flow Controller With A PID-Fuzzy Approach: Improves The Power Quality", Accessed: Nov. 12, 2025. [Online]. Available: https://www.academia.edu/download/112956747/ijeer_120124.pdf
4. N. Nireekshana, R. Ramachandran, and G. V. Narayana, "A New Soft Computing Fuzzy Logic Frequency Regulation Scheme for Two Area Hybrid Power Systems," *Int. J. Electr. Electron. Res.*, vol. 11, no. 3, pp. 705–710, 2023.

5. N. Nireekshana, R. Ramachandran, and G. Narayana, “A Novel Swarm Approach for Regulating Load Frequency in Two-Area Energy Systems,” *Int J Electr Electron Res*, vol. 11, pp. 371–377, 2023.
6. N. Nireekshana, R. Ramachandran, and G. V. Narayana, “A Peer Survey on Load Frequency Control in Isolated Power System with Novel Topologies,” *Int J Eng Adv Technol IJEAT*, vol. 11, no. 1, pp. 82–88, 2021.
7. N. Nireekshana, “A POD Modulation Technique Based Transformer less HERIC Topology for PV Grid Tied-Inverter,” in *E3S Web of Conferences*, EDP Sciences, 2025, p. 01001. Accessed: Nov. 12, 2025. [Online]. Available: https://www.e3s-conferences.org/articles/e3sconf/abs/2025/16/e3sconf_icregcsd2025_01001/e3sconf_icregcsd2025_01001.html
8. N. Nireekshana, R. Ramachandran, and G. V. Narayana, “An innovative fuzzy logic frequency regulation strategy for two-area power systems,” *Int. J. Power Electron. Drive Syst. IJPEDS*, vol. 15, no. 1, pp. 603–610, 2024.
9. N. Nireekshana, K. P. Reddy, A. Archana, and P. R. Kanth, “Solar-Assisted Smart Driving System for Sustainable Transportation,” *Int. J. Innov. Sci. Res. Technol.*, vol. 10, no. 8, pp. 168–173, 2025.
10. N. Nireekshana, M. A. Goud, R. B. Shankar, and G. N. S. Chandra, “Solar Powered Multipurpose Agriculture Robot,” *Int. J. Innov. Sci. Res. Technol.*, vol. 8, no. 5, p. 299, 2023.
11. N. NIREEKSHANA, A. SHIVA, A. FURKHAN, M. SRIDHAR, A. OMPRAKASH, and K. K. SHIVA, “SIX PULSE TYPE SEGMENTED THYRISTOR CONTROLLED REACTOR WITH FIXED CAPACITOR FOR REACTIVE POWER COMPENSATION,” *Int. J.*, pp. 3153–3159, 2024.
12. N. Nireekshana, “Reactive Power Compensation in High Power Applications by Bidirectional cascaded H-Bridge Based Statcom”, Accessed: Nov. 12, 2025. [Online]. Available: https://methodist.edu.in/web/uploads/naac/2019-11-19%2012_45_47pm%20152.pdf
13. N. Nireekshana, G. M. Krishna, A. George Muller, K. Sai Manideep, and M. Abdul Mukheem, “Power Quality Improving using FCL and DVR,” *Int. J. Innov. Sci. Res. Technol. IJISRT*, pp. 624–632, May 2024, doi: 10.38124/ijisrt/IJISRT24MAY025.
14. N. Nireekshana, R. Ramachandran, and G. V. Narayana, “Novel Intelligence ANFIS Technique for Two-Area Hybrid Power System’s Load Frequency Regulation,” in *E3S Web of Conferences*, EDP Sciences, 2024, p. 02005. Accessed: Nov. 12, 2025. [Online]. Available: https://www.e3s-conferences.org/articles/e3sconf/abs/2024/02/e3sconf_icregcsd2023_02005/e3sconf_icregcsd2023_02005.html
15. R. Jatoth and N. Nireekshana, “Improvement of Power Quality in Grid Connected Non Conventional Energy Sources at Distribution Loads,” *Grenze Int J Eng Technol GIJET*, vol. 4, no. 3, 2018, Accessed: Nov. 12, 2025. [Online]. Available: https://methodist.edu.in/web/uploads/naac/2019-11-19%2012_58_06pm%20201.pdf
16. N. Nireekshana, R. R. Chandran, and G. V. Narayana, “Frequency Regulation in Two Area System with PSO Driven PID Technique,” *J Power Electron Power Syst*, vol. 12, no. 2, pp. 8–20, 2022.
17. N. Nireekshana, S. Unissa, B. R. Jaleja, C. Mukta Tejaswi, P. Mangathayaru Mahitha, and P. Vaishnavi, “FACTS: Present and Future,” *Int. J. Innov. Sci. Res. Technol. IJISRT*, pp. 2350–2358, Oct. 2024, doi: 10.38124/ijisrt/IJISRT24SEP1424.



18. N. Nireekshana, "Design and Implementation of Single PHASERV Topology Five Level Inverter.," Grenze Int. J. Eng. Technol. GIJET, vol. 4, no. 3, 2018, Accessed: Nov. 12, 2025. [Online]. Available: https://methodist.edu.in/web/uploads/naac/2019-11-19%2012_58_19pm%20202.pdf
19. Namburi Nireekshana, Tanvi H Nerlekar, P. N. Kumar, and M. M. Bajaber, "An Innovative Solar Based Robotic Floor Cleaner," May 2023, doi: 10.5281/ZENODO.7918621.
20. Namburi Nireekshana, Onteru Divya, Mohammed Abdul Saquib Adil, Rathod Rahul, and Mohammed Shoaib Mohiuddin, "An Innovative SSSC Device for Power Quality Enhancement," Feb. 2024, doi: 10.5281/ZENODO.10670526.