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# Automatic Power Switching Mains for Various Sources

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***Abstract***

*This project's major objective is to autonomously choose from four possible power sources—mains, generator, inverter, and solar—to guarantee a load's continuous power delivery. This is crucial due to the rising demand for electricity and the frequent power disruptions affecting industries, hospitals, and households. Establishing an alternative power source is imperative to address this issue. In this project, four switches are utilized to simulate the failure of individual power sources. Pressing any of these switches indicates the absence of the corresponding power source. The microcontroller receives these controls as input signals. An 8051-family microcontroller is employed for this purpose. Relay driver integrated circuits (ICs) are linked to the output of microcontrollers to regulate the appropriate relay and maintain an uninterrupted supply of electricity to the load. The output will be monitored using a lamp that initially draws power from the mains supply. Upon failure of the mains supply (triggered by pressing the corresponding switch), the load receives power from the next available source, such as an inverter. The system moves on to the next accessible source if the voltage converter fails as well, and so on. An LCD also shows the status, which indicates which source is powering the load. Owing to practical limitations, only one source with alternating switches is offered to accomplish the same functionality as the four separate sources of supply.*

**Keywords:** Arduino Uno, relay driver, LCD, solar, UPS, and generator

## INTRODUCTION

With the increasing demand for power, reliance on electricity has become crucial, putting strain on distribution systems. This escalating demand, coupled with frequent power outages, poses challenges across various sectors such as industries, hospitals, and residential areas. As a result, provisions for other power sources are desperately needed. In this setup, the ATmega328P microcontroller is employed. Its output interfaces with the ULN2003, serving as a relay driver capable of operating up to 7 relays. These relays, rated at 12V, are utilized in the system. Output visualization is facilitated through a lamp. Power provision involves a step-down transformer converting 230V AC to 12V AC, subsequently rectified to DC via a Bridge rectifier. Automatic power switching mains systems provide a smooth way to combine power from several sources, guaranteeing a steady and dependable supply of electricity. The introduction, component requirements, functions, and applications of autonomous power switching mains are all thoroughly covered in this article. Engineers and enthusiasts alike can take use of these systems' capabilities to improve power management efficiency in a variety of contexts by learning about their subtleties.

The demand for automation has become increasingly essential in today's context. It offers user-friendly and time-saving features. Manual

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operations have always been common, and they still are in some places. For instance, people manually start the generator if the primary power source fails [1–4]. Automation in controlling electrical appliances enhances safety significantly. While providing all four different supply sources might not be feasible, a single source with an alternative parallel setup is offered to demonstrate functionality. However, if all four different sources are accessible, they can be utilized accordingly.

The capacity to smoothly transition between several power sources is crucial for ensuring an uninterrupted electrical supply in today's networked environment. This is accomplished by automatic power switching mains systems, which intelligently manage power from various sources, including batteries, generators, solar panels, and the grid [5–7]. These systems provide dependable, adaptable, and effective power management in residential, commercial, and industrial environments. This article explores automatic power switching mains' parts, specifications, functions, and uses to clarify their importance in today's electrical infrastructure. Figure 1 shows block diagram of the system

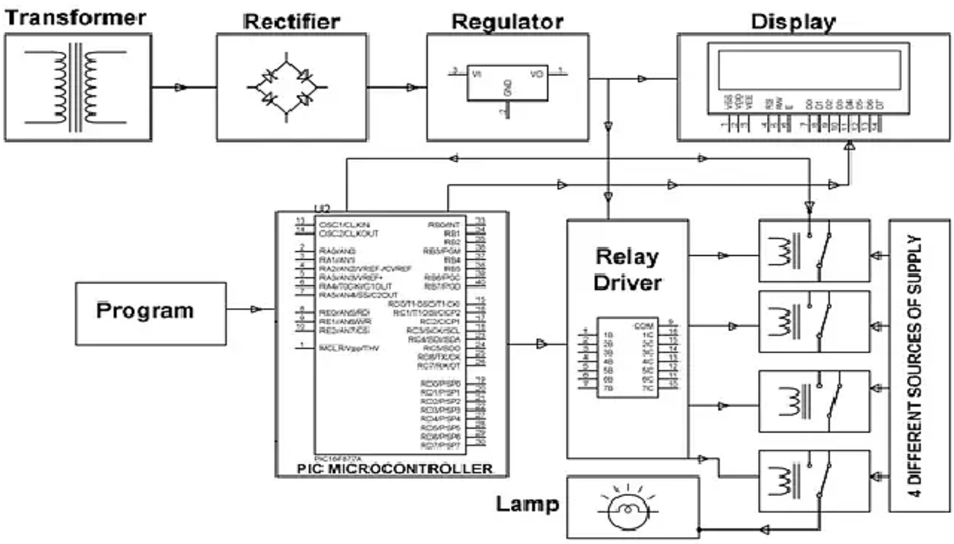


**Figure 1.** Block diagram of the system.

**Description of the Components**

The way each of the basic circuit units is developed and implemented, as well as how the programme is put into action to carry out the necessary functionality and regulate the plan.

The following actions were taken when designing this project:

1. Converter
2. LM7805A Voltage Regulator
3. Rectifier
4. The ATmega328, or Arduino Uno
5. Driver for Relays
6. LCD

**Transistor (12V/1A, 12V/500mA)**

12-0-12 Resign A general-purpose chassis attaching mains transformer is the Transformer 500 mA. Transformer features center-tapped secondary winding and primary windings rated for a voltage of 240 volts.

**DETAILS Voltage input: 230 V AC**

12V RMS or 24V RMS output voltage and 1 amp output current, respectively

 

*Mounting:* kind of vertical mount
Soft iron is the core. Minimal price and compact size

*LM7805 Voltage Regulator:* A voltage regulator with a +5 volt source is the LM7805. Voltage regulator characteristics include: Three-terminal regulators; Maximum current up to 1.5A; Internal thermal overload protection; and High energy dissipation efficiency [8]. Integrated Limiting of Short-Circuit Current and SAFE-Area Compensation of Output Transistors.

*Power Source Inputs:* Automatic power switching mains systems can accept power from a number of sources, such as batteries, renewable energy sources like solar panels, backup generators, and the main electrical grid. The main sources of energy are these inputs, each of which has unique benefits in terms of cost, availability, and environmental effect.

*Automated Transfer Switch (ATS):* An essential part that makes power source switching automated is the ATS. It oversees smoothly shifting the load to a backup power source in milliseconds during blackouts or other disruptions by disconnecting it from the main power source. By preventing interruptions and downtime in electrical systems, the ATS guarantees continuous power delivery to vital loads.

*System of Energy Storage:* Energy storage systems are essential for storing extra energy for later use in systems that use backup batteries or renewable energy sources. During grid outages or times when renewable energy generation is limited, these systems—which could consist of lead-acid batteries, lithium-ion batteries, or other energy storage technologies—provide backup power.

**Bridge Rectifier**

Next stage was the AC/DC conversion process that involved inverting the negative cycles of the AC input. The process required the use of a full wave rectifier diode bridge and required specific bridge rectifier that would be able to handle a peak voltage of 20V and 2A. The 2W04G rectifier was used for simulation process.

At 220V; $input\ voltage\ Vs = 12V$

$Output\ dc\ voltage = 0.9Vs = 0.9 \times 12 = 10.8V$

The bridge rectifier delivers pulsating DC.

$Ripple\ factor = \sqrt{(Vrms/Vdc)^2 - 1} = \sqrt{(12/10.8)^2 - 1}$^0.5 = 0.66

$Efficiency = Pdc/Prms \times 100\% = (10.8/12) \times 100\% = 90\%$

*Arduino UNO:* The ATmega328P is the basis for the Arduino Uno microcontroller board (datasheet). It contains a 16 MHz quartz crystal, 6 analogue inputs, 14 digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; all you need to do is use a USB cable to connect it to a computer. The Arduino Uno's ATmega328 has a boot loader pre-programmed into it that enables you to upload new code without using an external hardware programmer. It uses the original STK500 protocol for communication. Additionally, it contains a 1 KB EEPROM and 2 KB SRAM that can be read and written using an EEPROM library. The Uno's 14 digit pins can all be utilised as inputs or outputs by applying the corresponding functions. They run on five volts. Each pin has an inbuilt pull-up resistor ranging from 20 to 50 k ohm, and it is recommended that they deliver or receive 20 mA under these conditions. The board that makes up the Arduino Uno can be powered by an external 7–12 volt power source or by connecting it to a USB source of electricity.

*Driver for Relays:* This is a relay interface board with four 5V channels; each channel requires driver current ranging from 15-20mA. It can be used to regulate a variety of high-current appliances and apparatus. It has high-current relays that can operate at DC30V or AC250V 10A. It features a common interface that a microcontroller can use to directly operate it. The four-channel relay module has the necessary switching and isolation elements along with four 5V relays, making it simple to interface with a microcontroller or sensor with the fewest possible parts and connectors. The switch contacts on each relay are set for 250VAC and 30VDC and 10A in each.

**WORKING**

This project employs a setup utilizing four distinct supply sources to ensure continuous operation of a load. Recognizing the impracticality of obtaining all four supply sources individually—main supply, solar supply, energy storage, and generator supply—we opted for a single source coupled with a set of relays. We designated the first source to have a solar supply, simulating connection to all four sources in parallel as shown in Figure 2.

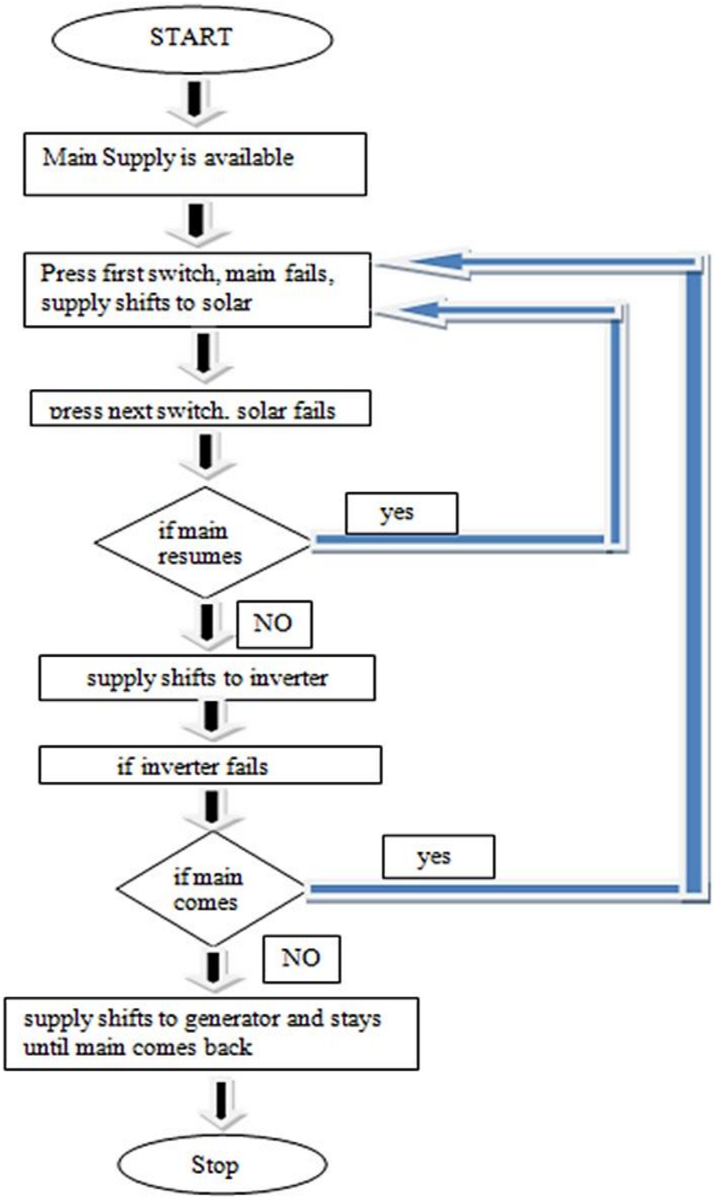


**Figure 2.** Flow chart of the system.

To connect the lamp's AC source, we parallelized all normally open and common contacts across four relays. Four push button switches, each representing the failure of a corresponding supply, interface with the controller. Initially, a high input signal is applied to the microcontroller, prompting it to generate a low output, activating the first relay driver and illuminating the lamp.

 

When the solar button is pressed, simulating a solar supply failure, the supply switches to the next source. To engage the second relay driver and light the bulb via the second relay, the microcontroller receives a high input and produces a low output. Similarly, pressing the energy storage button signifies a failure, prompting the supply to switch to the next source. The third relay is activated accordingly, maintaining lamp illumination [9–12].

Pressing the third button indicates a switch to the next source, activating the fourth relay via input to the microcontroller. The load receives the supply, and the lamp continues to illuminate. When all relays are deactivated, cutting off the supply to the lamp, it switches off. Additionally, a 16 × 2 lines LCD provides real-time updates on the status of the supply sources and the load as shown in Figure 3.

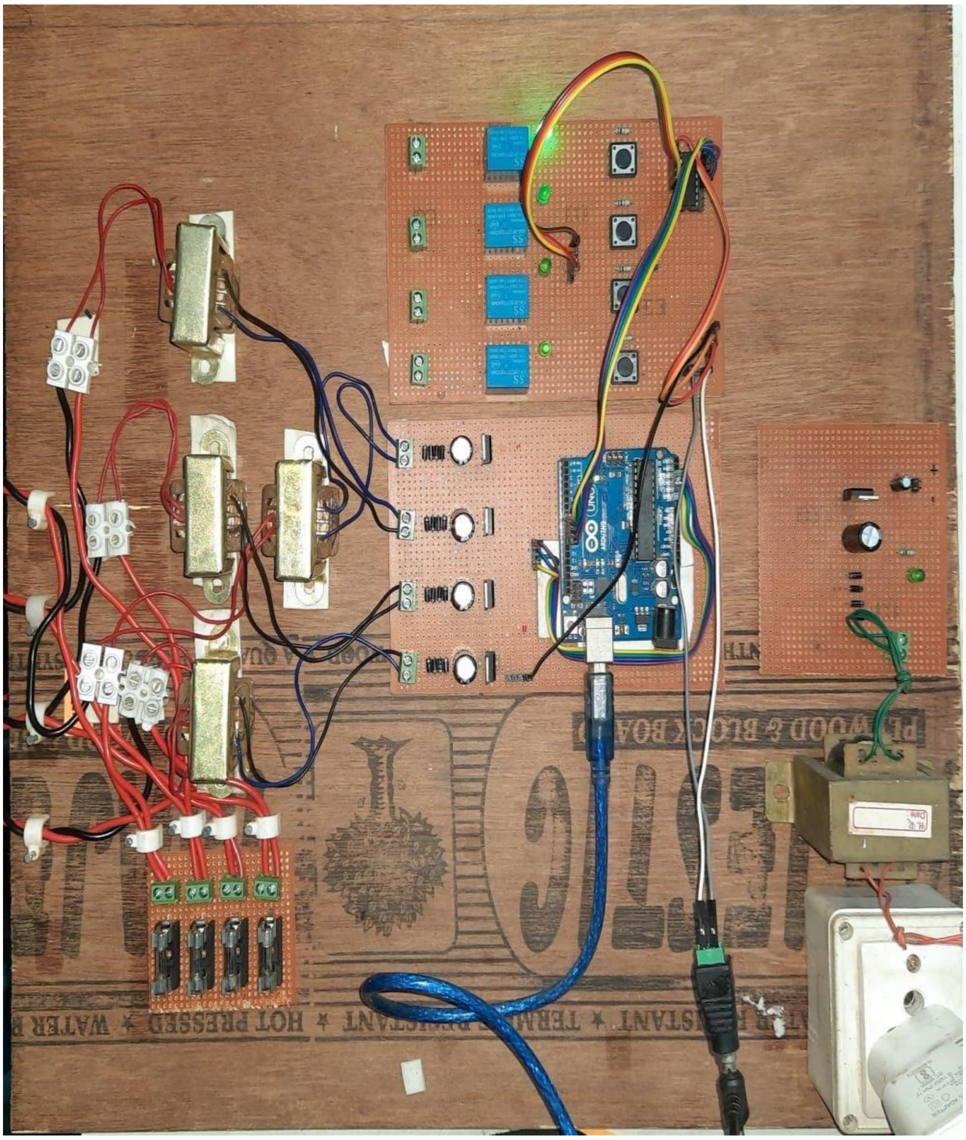

**Figure 3.** Prototype of the proposed system.

Three cases are depicted in Figure 4.

a. When the mains are active solar supply fails, the energy storage system is activated.
b. When the solar supply is active.
c. When energy storage fails, the generator set is activated.

The switch status for the power supply is presented in Table 1.

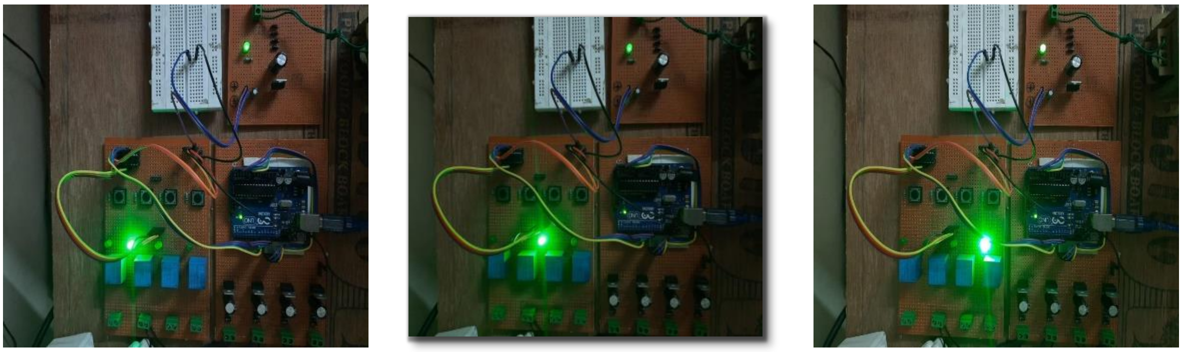

**Figure 4.** Output for case 1, case 2, case 3.

**Table 1.** showing results of power supply circuit of the microcontroller.

| Power source | Input of the power source (VAC) | Switch status | LCD Display | Load status |
|---|---|---|---|---|
| Mains | 230V | ON | MAINS | Bulb lights |
| Mains | 230V | OFF | NO POWER | No light |
| Solar | 230V | ON | SOLAR | Bulb lights |
| Solar | 230V | OFF | NO POWER | No light |
| UPS | 230V | ON | UPS | Bulb lights |
| UPS | 230V | OFF | NO POWER | No light |
| Generator | 230V | ON | GENRATOR | Bulb lights |
| Generator | 230V | OFF | NO POWER | No lights |

## Applications

Mains systems with automatic power switching find use in a variety of contexts, such as:

- *Residential Buildings:* These systems provide the continuous operation of vital utilities like lighting, refrigeration, and communication equipment in residential settings by providing backup power during grid disruptions. Additionally, they make it possible for households to incorporate renewable energy sources like wind turbines and solar panels, which lessens dependency on the grid and lowers electricity costs.
- *Commercial Establishments:* Automatic power switching mains systems protect sensitive equipment and vital processes from power outages in commercial buildings such as stores, restaurants, and offices. By facilitating smooth transitions between backup generators and grid electricity, these technologies help to preserve customer happiness and productivity.
- *Industrial Facilities:* Automated power switching the mains technologies are vital for reducing production downtime and averting expensive equipment damage in industrial settings where continuous power is required for machinery operation and manufacturing processes. They also make it possible to integrate renewable energy sources, which lowers energy prices and the carbon footprint of enterprises.
- *Telecommunication Infrastructure:* In order to sustain connectivity and essential communication services, telecommunication networks significantly depend on a steady power supply. Even in isolated or off-grid areas, automatic power switching mains systems smoothly transition between grid power, backup generators, and energy storage systems to provide dependability and resilience in the telecommunications infrastructure.

## Future Scope

India ranks as the seventh-largest country globally. It hosts a multitude of industries that demand consistent power supply to operate seamlessly. These industries cannot tolerate any interruptions in their processes due to power shortages. To tackle this issue, we designed a mechanism that guarantees a constant supply of power. By minimizing delays, our system facilitates swift switching between power sources, ensuring that in the event of a failure in the current source, the load is seamlessly transferred to an alternate source within moments. The incorporation of sensors for source detection enables rapid switching, guaranteeing immediate power restoration upon the failure of the primary power source. Our future involves extending this project to incorporate renewable energy sources, further enhancing sustainability and reliability.

## CONCLUSION

The project delves into elucidating the concept of a power supply sourced from four distinct outlets: Solar, Inverter, Main, and Generator. Through comprehensive detailing of its features, this endeavor aims to amplify productivity by implementing auto-switching capabilities, thereby ensuring uninterrupted operation and expediting processes. The significance of this initiative resonates in its manifold advantages and broad spectrum of applications across diverse sectors such as industries, hospitals, and banks. It has been meticulously crafted by amalgamating features from various hardware components, including those relevant to educational institutions like colleges and schools. Each module's placement has been carefully deliberated to optimize the unit's functionality. Additionally, the project delves into an exploration of various switching techniques in each thesis.

## REFERENCES

1. V. Sudhakara Reddy, Prof. M. Damodar Reddy, “Optimization of Distribution Network Reconfiguration Using Dragonfly Algorithm”, Journal of Electrical Engineering, Vol.16, No.4, No.30, pp.273–282, 2017.
2. Kalyani S, A. V. Sudhakara Reddy and N. Vara Prasad “Optimal Placement of Capacitors in Distribution Systems for Emission Reduction Using Ant Lion Optimization Algorithm”, International Journal of Current Advanced Research, Vol.7, No.11, pp.16339–16343, 2018.
3. Robert L. Boyles tad and Louis Nashelsky Electronic devices and circuit theory eight editions. Prentice Hall (Pearson Education Inc.) 2002 pp 875 (Reference Book)
4. B L. Theraja and B. K. Theraja.A textbook of Electrical Technology. S. Chand and Company Ltd. New Delhi, India 2002 pp. 220, 920, 924, 1712 –1716. (Reference Book)
5. Y V Krishna Reddy, M. Damodar Reddy and A. V. Sudhakara Reddy “Flower Pollination Algorithm for Solving Economic Dispatch with Prohibited Operating Zones and Ramp Rate Limit Constraints”, Journal of Emerging Technologies and Innovative Research (JETIR), Vol.5, Iss.10, pp.498-505, 2018.
6. M. Shell. (2002) IEEEtran homepage on CTAN. [Online]. Available: http://www.ctan.org/tex-archive/macros/latex/contrib/supported/IEEEtran/
7. S. Sudhakara Reddy, N. Rajeswaranand V. K. V. Kesava, “Strategic Planning to Promote Engineering Projects in Community Service (EPICS) in Engineering Institutions,” 2018 World Engineering Education Forum - Global Engineering Deans Council (WEEF-GEDC), Albuquerque, NM, USA, 2018, pp.
8. Mahesh G, Kumar AV, Reddy KA, Sudha Y. Auto Power Supply Control from Four Different Sources. Journal of Research in Science, Technology, Engineering, and Management. 2021;5(1): 5–11.
9. Popoola AI, Akinpelu EO, Ewetumo T. Development and Performance Evaluation of an Intelligent Electric Power Switching System [J]. Journal of Trend in Scientific Research and Development. 2021 Mar;5(3).
10. Agbetuyi AF, Adewale AA, Ogunluyi JO, Ogunleye DS. Design and construction of an automatic transfer switch for a single-phase power generator. International journal of engineering science. 2011 May;3(4):1–7.
11. Barnwal R, Clark SW, Yogi B, Balal A. Automatic Transfer Switch for Critical Loads Between Renewables, Storage, Mains, or Generator. In2024 IEEE Texas Power and Energy Conference (TPEC) 2024 Feb 12 (pp. 1–5). IEEE.
12. Raji AA, Afolabi QB. Development of Microcontroller Based Automatic Power Switch with Generator Start And Stop Controls. FULafia Journal of Science and Technology. 2018 Dec 31;4(2):6–9.

 