

Design and Implementation of an Automatic Power Supply From Four Different Source Using Microcontroller

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ABSTRACT

This project is designed to automatically supply continuous power to a load through one of the four sources of supply that are: solar, mains, thermal, and wind when any one of them is unavailable. The four switches represent the four causes. The switches are connected to an 8051 microcontroller of which they provide input signals. Whenever a switch is pressed, it shows the absence of that particular reference. A relay driver is used that receives microcontroller generated output and switches that specific relay to provide continuous power supply. A lamp or bulb was used as a load for demonstration purpose which draws power from main. When the primary fails to supply power, automatically next available source was used like thermal. If thermal fails then the next one is used and so on. An LCD is used to show which power supply is on.

Keywords: 8051 Microcontroller, Relay driver, LCD, Thermal, Wind and Solar.

1. INTRODUCTION

For a very long time, power outages, power interrupts and also unexpected routine power line maintenance is one of the major problems faced in industries, hospitals, offices, and homes whole over the world. For that case, this project provides an automatic operation of electrical power distribution systems; the rapid and reliable transfer of the system from one power source to another during specific events such as power outages, power interrupts, routine power line maintenance, to achieve the reliability of such systems[1-2].

Electrical power supply is one of the primary essential needs of human life today, that is to say, without electrical power supply, most human works become stand still, postponed and even cancelled since most human actions are dependent on the electrical power supply.

Furthermore, the need for power supply through access to electricity by the masses of the population of any country, both developed and developing countries is very important to the development of the economy of that particular country. In other words, the power sector plays an essential role in the socio-economic development of any country[3].

Therefore, this project provides a practical solution to provide an alternative power supply or uninterrupted power supply in automated mode to the load during frequent power cuts or in cases where power cuts or power outages cannot be avoided.

2.0 MATERIALS AND METHODS

Block Diagram of the System

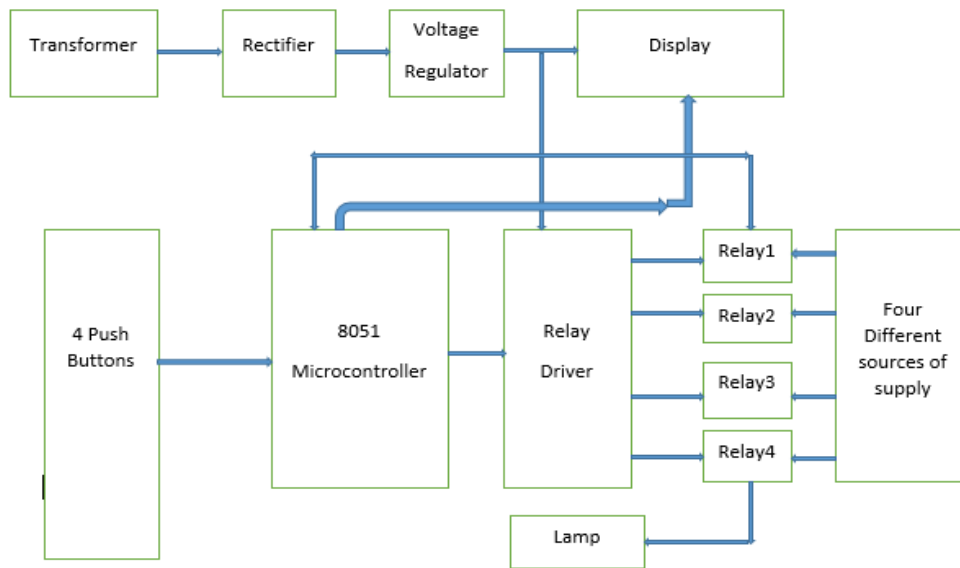


Figure 1.0 shows block diagram of the system

Components Description

The design and implementation of each of the fundamental circuit units and how the program is designed to be implemented , control the plan and perform the required functionality.

The steps involved in designing this project includes:

- Transformer
- Bridge Rectifier
- Filter capacitor
- Voltage Regulator LM7805A
- Resistor
- Relay Driver
- LCD
- 8051 Microcontroller

2.1.0 TRANSFORMER

This system uses a step down transformer which converts 230V AC to 12V AC with less power loss depending on the *turns* ratio.

The input ac varies in the event of input ac at 230V AC section varies from 160V to 270V in the ratio of the transformer primary voltage V_p to Secondary Voltage, V_s governed by formula;

$$(V_p/V_s) = (N_p/N_s)$$

Thus, if the transformer delivers 12V at 220V input, it will give;

At 160V; $(160/V_s) = (220/12)$

$$V_s = (160 \times 12)/220 = 8.72V$$

A 270V; $V_s = (270 \times 12)/220 = 14.72V$

Therefore, a step down between 8V to 15V was sufficient since current limitation was handled by the regulator.

2.1.1 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* $V_s = 12V$

$$\text{Output dc voltage} = 0.9V_s = 0.9 \times 12 = 10.8V$$

The bridge rectifier delivers pulsating DC

$$\text{Ripple factor} = \sqrt{\{(V_{rms}/V_{dc})^2 - 1\}} = \sqrt{\{(12/10.8)^2 - 1\}}^{0.5} = 0.66$$

$$\text{Efficiency} = P_{dc}/P_{rms} \times 100\% = (10.8/12) \times 100\% = 90\%$$

2.1.2 FILTER CAPACITOR

The capacitance value was needed to minimize the voltage ripple. The output of the transformer was 12V AC at 50Hz. The required minimum capacitor value can be calculated from the formula;

$$C = I_{out} / (2 \times f \times R_F \times V_{in})$$

$I_{out} = I_{max} = 1A$, since it is the maximum output current of the LM7805 regulator

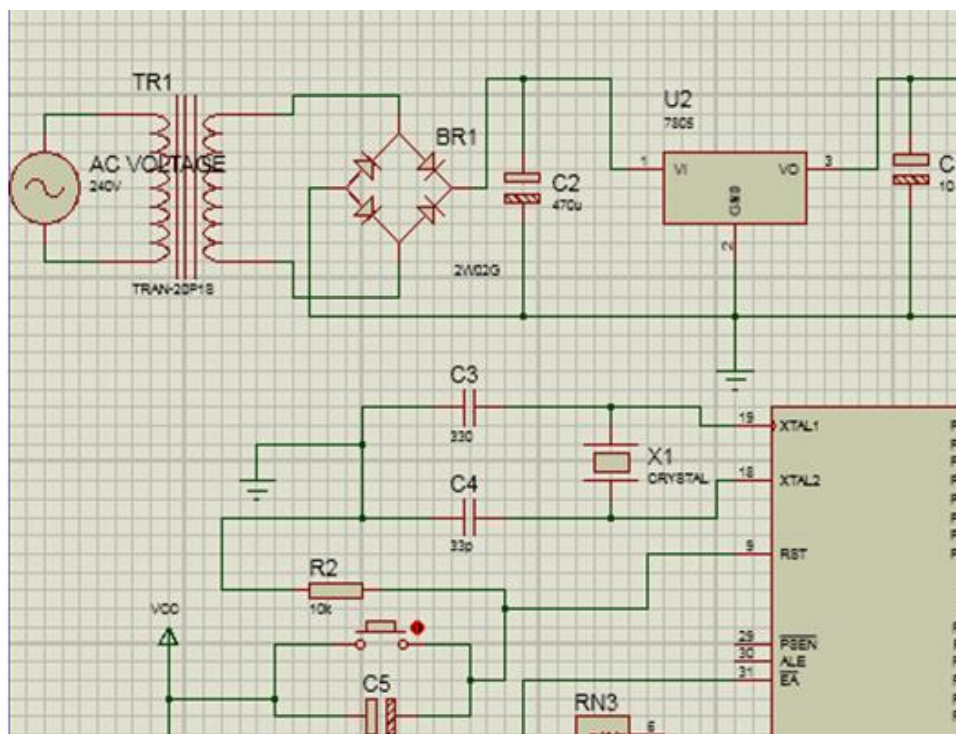
$$C = 1 / (2 \times 50 \times 0.66 \times 12) \cong 1000\mu F$$

Therefore, an electrolytic capacitor of about $470\mu F$ to $1000\mu F$ to filter the output DC from the bridge rectifier.

2.1.3 VOLTAGE REGULATOR LM7805

Since the filtered DC being unregulated, IC LM7805 was used in simulation process to get 5V DC at its pin number 3 irrespective of input DC varying for 8V to 15V, and the regulated output from the LM7805 remains at a 5V constant. The regulated 5V DC is further filtered by a small electrolytic capacitor of $10\mu F$ for any noise generated by the circuit.

STANDARD CONNECTIONS TO THE AT89S51



3.0 WORKING PRINCIPLE

This project uses an arrangement where four different sources of supply are channelized to a load to have an uninterrupted operation of the load. As it is not practicable to get four sources of supply such as mains supply, wind supply, thermal supply and solar supply, we use relays only. The project has taken one source of 230v mains supply and assumed as if being fed from 4 different sources by connecting all the four incoming sources in parallel as seen in the schematic circuit diagram. The ac source to the lamp is connected to relay 1 to relay 2 to relay 3 and relay four by making the entire 'NO' (normally open)

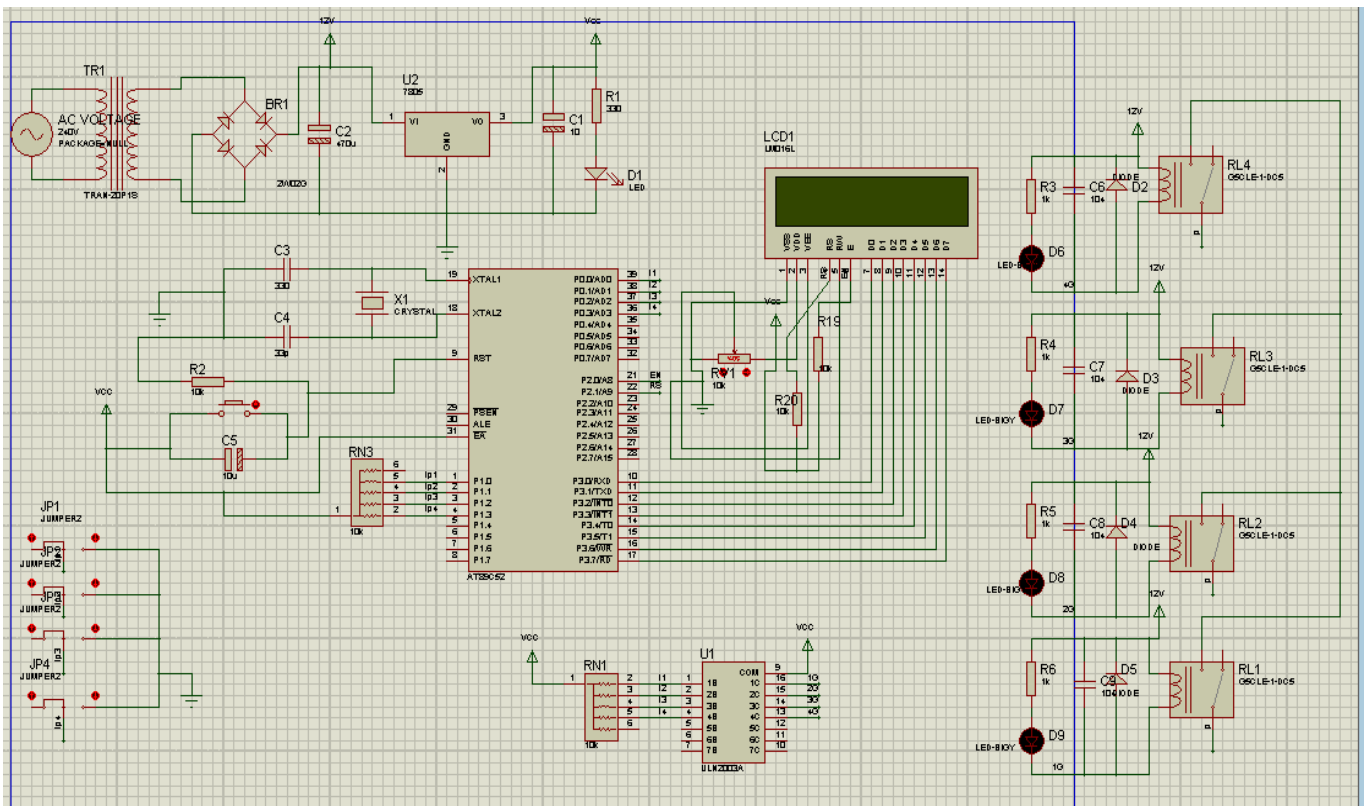
contacts parallel and all the typical contacts in parallel. Four push button switches representing a failure of corresponding supply such as mains, wind, thermal, solar are respectively connected to port 3.4, 3.5, 3.6 and 3.7.

3.0.1 LOGIC DESIGN

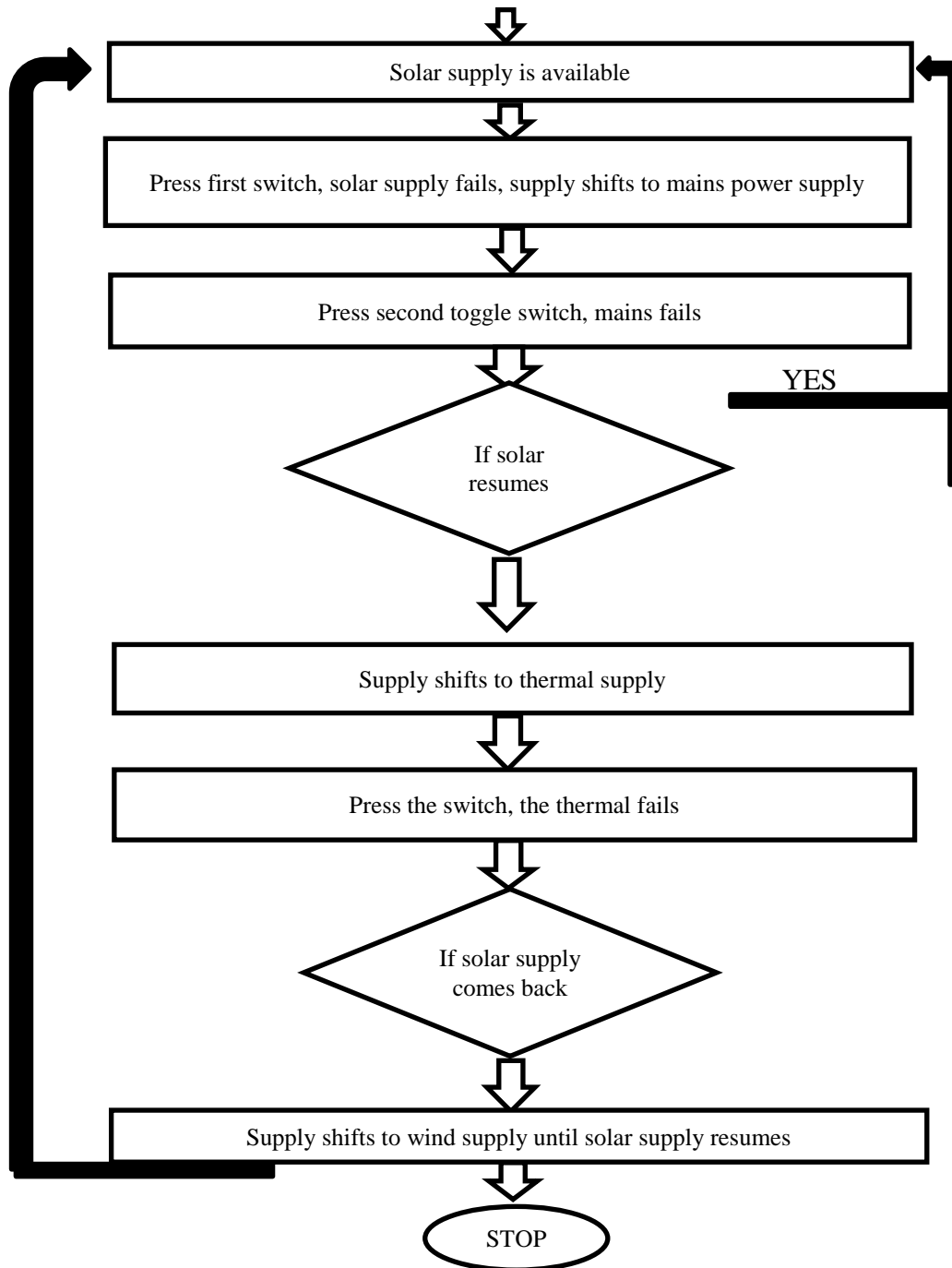
The project basically supplies continuous power to a load in automated mode through one of the four sources of supply that are: solar, mains, thermal, and wind when any one of them is unavailable.

Four switches are used for four respective sources. These are connected to a microcontroller of 8051 families that provides input signals to it. Whenever a switch is pressed, it shows the absence of that particular source. A relay driver receives microcontroller generated an output signal and switches that particular relay to provide continuous power supply. A lamp was used as a load for demonstration purpose which draws power from main. When mains fails to supply power, automatically next available source is used say thermal. If thermal fails then the next one is used and so on. An LCD is also used to display which source is being currently used for power supply.

Schematic Circuit Diagram



3.0.2 Flow Chart of the system



4.0 RESULTS AND DISCUSSIONS

CONSTRUCTION

The construction of the project is done based on the components layout, components assembly on Vero board and soldering process followed on making up the circuit to make sure that all components are permanently mounted

4.0.1 TESTING

Continuity test was carried out to check if there was current flow in the project circuitry and was aimed at finding electrical open paths in the circuitry after completing soldering and configuration. A multimeter was used to perform a continuity test on the electric circuit by measuring electric current flow.

Procedures

- a. A multimeter is kept in buzzer mode.
- b. Then it is connected to the ground terminal of the multimeter then to the ground
- c. Finally, both terminals are connected to the path that needs to be checked, and there is continuity in the way, the multimeter would produce a beep sound.

4.2 Results and Discussion

Output of the bridge rectifier	Input into the voltage regulator	Output of voltage regulator	Input into the microcontroller (Vcc)
11.9VDC	10.4VDC	5.0VDC	5.0VDC

Table 1.0 showing results of power supply circuit of the microcontroller

Power source	Input of the power source (VAC)	Switch status	LCD Display	Load status
Solar	230V	ON	SOLAR	Bulb lights
Solar	230V	OFF	NO POWER	No light
Mains	230V	ON	MAINS	Bulb lights
Mains	230V	OFF	NO POWER	No light
Wind	230V	ON	WIND	Bulb lights
Wind	230V	OFF	NO POWER	No light
thermal	230V	ON	THERMAL	Bulb lights
thermal	230V	OFF	NO POWER	No lights

RESULT

This project prototype was implemented, tested and integrated before testing the entire system. The input from the four sources is given to the microcontroller.



Figure 1 showing snapshot of the project system

Then the output of the microcontroller is given to the relay which maintains continuous power supply to the load. Finally, the current status of the available source is displayed on the LCD.

5.0 CONCLUSION

This project of **AUTOMATIC POWER SUPPLY FROM FOUR DIFFERENT SOURCES** (Solar, Mains, Wind, and Thermal) **USING A MICROCONTROLLER** is used to handle power supply from mains, solar, wind and thermal most effectively. The outline of the project is the selection of supply from mains, solar, wind and thermal automatically using microcontroller concept. The significance of this project lies in the various and wide places of applications such as; schools, hospitals, and most especially manufacturing industries and mining industries where a continuous supply of power is vital.

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