

Multi Power Supply Using 4 Different Sources for No Break Power Supply

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ABSTRACT:Power is most important requirement for all of us. We know that due to large demand of electricity and due to limit capacity of power plant at generating station, power cut off is common for all us. Due to limited amount of power generation at power station and due to shortage of nonrenewable continuous supply source it brings a biggest challenge in whole world. If you see all around us you will observe that due to discontinuity of power supply, many problems have been faced by people in their everyday use. This type of power failure create problem for data centers, hospitals and some research work. This is a biggest reason that every countries are researching for the work to supply a continuous power with good efficiency and with good regulation. In this project we can combine the renewable and non-renewable energy sources to get the continuous power supply such as mains, solar, inverter, small diesel generator. The power cut of these sources can be manually done by switches. The continuous supply to load can be given by automatic operation of relay, relay driver IC with the help of Arduino Nano.

In present time's electric supply is very essential to the human beings. Uninterrupted power supplies are needed in almost all of the areas in our life-in household applications, research institutions, hospitals etc. Due to the increased demand of power and large consumption of conventional energy sources, which are limited in nature, there is a need to shift from conventional methods of energy production to a better approach using hybrid systems to economically use the conventional and non-conventional sources. This paper deals with the automation of switching between different sources so as to get uninterrupted power supply and that to at low economical cost. Multiple sources increase the reliability of the system and the system is more robust to power failures and faults. The project implements micro controller based circuit with relays to facilitate automatic prudent shift of power supply from the various available sources.

KEYWORDS: Relay Driver IC, LCD,.,arduino Nano.

I. INTRODUCTION

The project is designed to automatically supply continuous power to a load through one of the four sources of supply that are: solar, mains, generator, and inverter when any one of them is unavailable. Four switches are used for four respective sources. These are connected to Arduino nano family that provides input signals to it. Whenever a switch is pressed it shows the absence of that particular source. A relay driver is used that receives microcontroller generated output and switches that particular relay to provide continuous power supply. A lamp is used as a load for demonstration purpose which draws power from main. When main fails to supply power, automatically next available source is used say inverter. If inverter fails then the next one is used and so on. An LCD is also used to display which source currently used. Therefore, this project provides an effective solution to provide an alternative power supply during frequent power cuts. In this project uses four switches to demonstrate the respective failure of that power supply. When any of the switches is pressed it shows the absence of that particular source, switches are connected to microcontroller as input signals. The output of Arduino nano is given to the relay driver IC, which switches appropriate relay to maintain uninterrupted supply to the load. The output shall be observed using a lamp drawing power supply from mains initially. On failure of the mains supply (which is actuated by pressing the appropriate switch) the load gets supply from the next available source, say an inverter. If the inverter also fails it switches over to the next available source and so on. The current status, as to which source supplies the load is also displayed on an LCD. As it is not feasible to provide all 4 different sources of supply, one source with alternate switches are provided to get the same function.

II. REVIEW OF SYSTEM DESIGN

PRINCIPLE:

This project uses an arrangement of four different sources of supply which are channelized to a load so as to have an uninterrupted operation of the load. As it is not practicable to get four sources of supply such as solar supply, inverter supply, main supply and generator supply, we used one source and a set of relays. We have taken first source with solar supply and assumed as if being fed from four different sources by connecting all the four incoming sources in parallel. The ac source to the lamp is connected to four relays by making the entire normally open contacts parallel and all the common contacts in parallel. Four push button switches are used which represent failure of corresponding supply respectively and are interfaced to the controller. Initially we have given high input signal to the microcontroller, so as a result the controller generates a low output to activate the first relay driver which will result in the relay being energized and the lamp glows. While the push button for solar is pressed that represents failure of solar supply as a result the supply is provided from the next source and the microcontroller receive high input and generates low output to activate the second relay driver which will result in the second relay being energized and the lamp glows . When we press the inverter button, it indicates the inverter or fails to operate and the supply comes from the next source and the next source will supply high input to the controller and which will provide low signal to the third relay and the lamp switches ON and when we press the third push button the supply will chose next source now the fourth source will provide input to the microcontroller and controller activates the fourth relay and the load will get the supply and the lamp continues to glow. When all the relays are off leaving no supply to the lamp, the lamp is switched off. One 16 x 2 lines LCD is used to display the condition of the supply sources and the load on real time basis.

RELAY MODULE:

The relay module comprises of eight electro-magnetic relays which are controlled by the outputs on the digital pins of the Arduino microcontroller. The relays are used to switch on the required number of capacitors as required for power factor correction. The relays are normally in the Normally Open (NO) state and the contacts are closed only when the logic on any of the digital pins is high. As the logic on a pin goes high, the Normally Open contacts of the relay are now closed and the corresponding capacitor is connected in parallel with the load.



Figure 1:Relay Module

The relay module is interfaced with the digital pins of the Arduino microcontroller using a parallel port and bus. The relay driver is supplied with a voltage of 12V from the power supply. Each of the relays has an LED connected across its terminals to indicate that the relay has been switched on and is functional.

Specifications and Features: -

1. One normally closed contact and one normally open contact
2. Channel: 4 channel
3. Relay Operating Voltage: 3.3V to 5V
4. Pull-down circuit for avoidance of malfunction
5. Power supply indicator and Control indicator led.
6. Input signal, signal, common Terminal and start conducting.
7. Useful for appliance control;

8. DC or AC signal, control, you can control the 220V AC load;
9. There is a normally open and one normally close contact.

ARDUINO NANO:

Arduino is an open-source electronics prototyping platform based on flexible, easy to use hardware and software. It is intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer.

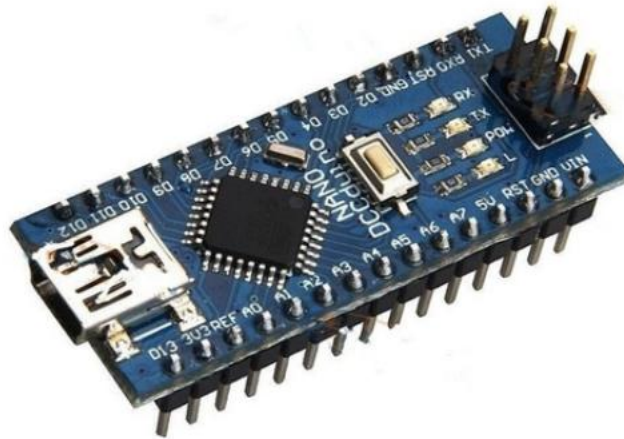


Figure 2:Arduino Nano

Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a smallest, complete, and breadboard friendly. It has everything that has electrically with more analog input pins and onboard +5V AREF jumper. Physically, it is missing power jack. The arduino Nano is automatically sense and switch to the higher potential source of power, there is no need for the power select jumper. Each of the 14 digital pins on the Nano can be used as an input or output, using pin mode, digital write, and digital read functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull up resistor (disconnected by default) of 20-50 kohms.[8]

In Addition, Some Pins Have Specialized Functions:-

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog Write function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the arduino language.

- LED: There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW value, and then it's off. The Nano has 8 analog inputs, each of which provides 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the analog reference function. Analog pins 6 and 7 cannot be used as digital pins. Additionally, some pins have specialized functionality:
- AREF : Reference voltage for the analog inputs. Used with analog Reference.

I2C. I2C communication is developed using A4 and A5 pins where A4 represents the serial data line (SDA) which carries the data and A5 represents the serial clock line (SCL) which is a clock signal, generated by the master device, used for data synchronization between the devices on an I2C bus.

Relay Driver IC UNL2003 :

ULN2003 is a relay driver IC consisting of a Darlington array. It is made up of seven open collector Darlington pairs with common emitter. Moreover, **ULN2003A** has a capability of handling seven different Relays simultaneously. A single Darlington pair consists of two bipolar transistors and operates in the range of 500mA to 600mA current.

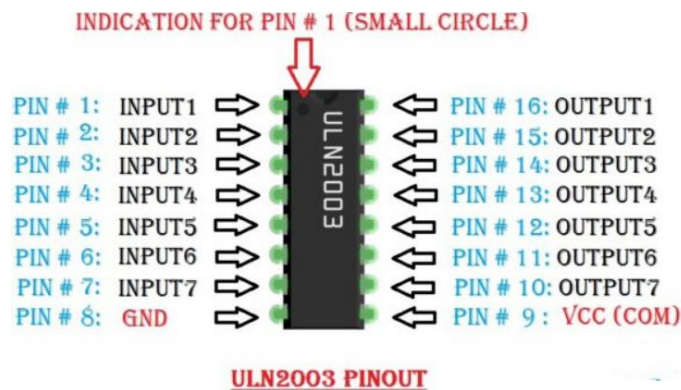


Figure 3:ULN2003 Pin out

A single Darlington pair consists of two bipolar transistors and it operates on the current range of 500mA to 600mA. ULN200X is a well-known series of IC's. ULN2003 is also the part of this series. ULN2003 operates on 5V and TTL (Transistor Transistor Logic) and CMOS (Complementary Metal Oxide Semi-Conductor). Its pin configuration is designed so that the input pins are at the left side of the IC where as the output pins of it are on right side in front of the corresponding input pin. This IC has a very wide range of applications. They are commonly used as relay drivers in order to drive different kinds of loads. ULN2003A can also be used to drive different motors. Some of the other applications OF *ULN2003* include logic buffers, lamp drivers, line drivers, LED display, motor driver circuits etc.It is made up of seven open collector Darlington pairs having common emitter which shows ULN2003 has a capability of handling seven different relays at a time.

LCD DISPLAY:

The LCD will require a total of 7 data lines (3 control lines plus the 4 lines for the data bus). If an 8-bit data bus is used the LCD will require a total of 11 data lines (3 control lines plus This is an example for the Parallel Port. This doesn't use the Bi-directional feature found on newer ports, thus it should work with most, if not all Parallel Ports. It however doesn't show the use of the Status Port as an input. A 16 Character x 2 Line LCD Module to the Parallel Port. A 16x2 LCD means it can display 16 characters per line and



Figure 4: LCD Display

There are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

III. PROPOSED SYSTEM

Microcontroller base automatic controlling of power factor with load monitoring is shown in fig.

The principle element in the circuit in Arduino nano board. The current and voltage single are acquired from the main AC line by using Current Transformer and Potential Transformer. These acquired signals are then pass on the zero crossing detectors. Bridge rectifier for both current and voltage signals transposes the analog signals to the digital signal. Microcontroller read the RMS value for voltage and current used in its algorithm to select the value of in demand capacitor for the load to correct the power factor and monitors the behavior of the enduring load on the basis of current depleted by the load.

At normal condition i.e. when mains supply is present, relay connected to mains sense the output from the mains and load is driven by mains supply. All other sources which are connected in parallel are open at this time. In case mains supply is cut off, power is automatically drawn from second source i.e. solar. If solar supply is absent the microcontroller will switched to inverter supply.

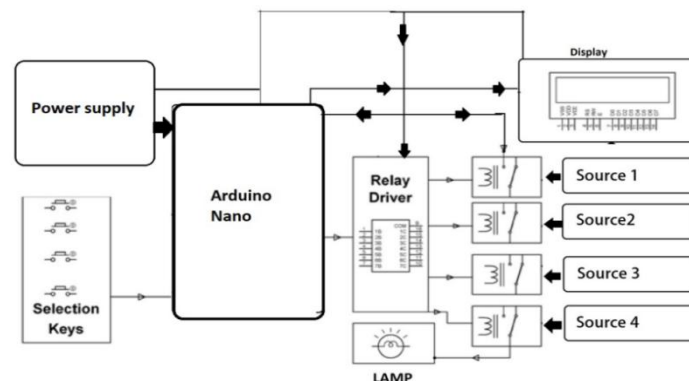


Figure 5: Block Diagram

If inverter supply also fails, the supply will automatically shift to generator. One of the other possible case is when power switches from one source to another source, say solar supply fails and supply shifts to inverter and at the same time if mains supply comes back then the supply will automatically switched to mains supply instead of switching to inverter because mains supply has been given the highest priority. The selection process of sources is done automatically using microcontroller. In this system microcontroller is very essential component and always keep sensing the available sources. When any source is switched off through the selection keys then the microcontroller shifted the load to the other supply source by giving the signal to the relay driver IC then the relay driver IC switched on the appropriate load relay. Load relays used in this work are connected in parallel with load and four sources of supplies are also connected in parallel with these load relays. These load relays consist of normally open and close contacts and are operated through the relay driver IC. We have checked this system by connecting the lamp at output side as a load. When any interruption takes place in the power supply lamp will not blink during the shifting of sources. Otherwise there will be blinking during the shifted time of the sources i.e. there is interruption in supplying the power at output side of the work.

CIRCUIT DIAGRAM:

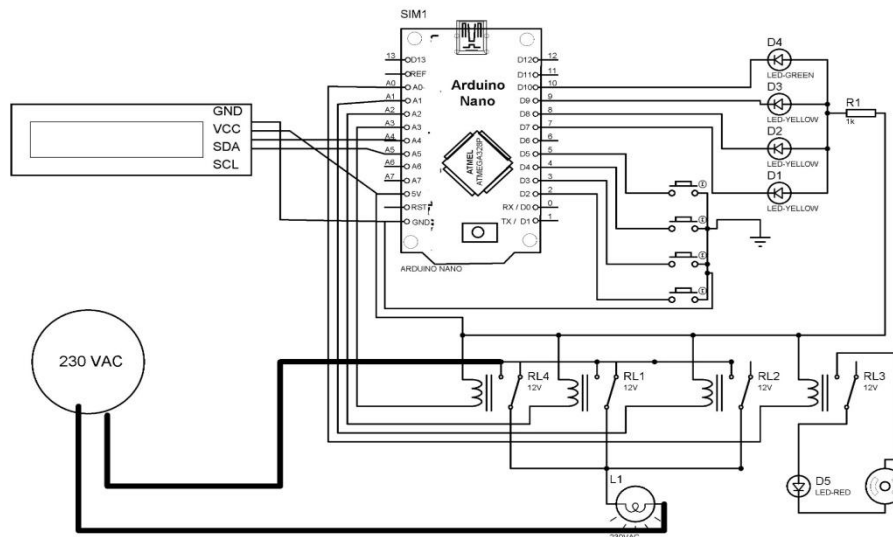


Figure 6:Circuit Diagram

WORKING:

In our system we use Arduino nano, relay board, switches,led,lcd display.Arduino nano is main part of the system. All module & switches interface to Arduino nano .arduino nano process signal depending upon program structure & give signal to relay board.

In this project uses four switches to demonstrate the respective failure of that power supply. When any of the switches is pressed it shows the absence of that particular source, switches are connected to microcontroller as input signals. The output of Arduino nano is given to the relay , which switches appropriate relay to maintain uninterrupted supply to the load. The output shall be observed using a lamp drawing power supply from mains initially. On failure of the mains supply (which is actuated by pressing the appropriate switch) the load gets supply from the next available source, say an inverter. If the inverter also fails it switches over to the next available source and so on. The current status, as to which source supplies the load is also displayed on an LCD. As it is not feasible to provide all 4 different sources of supply, one source with alternate switches are provided to get the same function. We use I2C module for lcd display.i2c lcd module has 4 pin vcc,gnd,sda,scl .four pin interface to Arduino nano.using i2c module no of connection with Arduino nano reduce also reduce complexity for diplay on lcd display. When all the relays are off leaving no supply to the lamp, the lamp is switched off. One 16 x 2 lines LCD is used to display the condition of the supply sources and the load on real time basis.we use 4 led for indication of which source currently being use. depending upon program Arduino nano process signal & give signal to relay board for activate relay for load supply.

IV. DEVELOPMENT STAGES & PROCESS

The complete development of this system can be divided into the following stages:

- Problem definition stage
- Designing block diagram
- Implementing circuits and components
- Developing algorithm for software
- Writing actual code for Microcontroller
- Compiling the code
- Testing and Running.

Problem definition stage

This is the very first stage to develop any project. It actually defines the aim and the concept of the project.

Designing block diagram

At this stage we have categorized the whole system into different individual modules. These modules (block diagrams) will be helpful in understanding the concept and working of the integrated system. It also simplifies the entire debugging and testing process.

Implementing circuits and components

This is the actual implementation of circuit of each block. At this stage we have actually designed each block separately and finally integrated them into the complete working system.

Developing algorithm for software

To get the logical flow of the software, the development of algorithm is having a prominent role. So that we have analyzed the complete system and organized the algorithm in such a manner that one can understand the complete working of the software.

writing actual code for Microcontroller

After the development of the algorithm and flowchart we have actually translated them in C language for Atmega328 Microcontroller so that it can understand the instructions and run as per our requirement.

Compiling the code

The code is implemented on the computer for which we have used Arduino IDE pre-installed on PC. Proteus software used for simulates working of Microcontroller in real time without burning the software into actual IC. We simulated and compiled our program for error checking. After removing of several compiling errors the program was converted into machine language.

Testing and Running

This time we tested our project for actual working, after loading the software into the microcontroller. Any errors found were removed successfully. This is the last and final stage of development of our project.

V. CONCLUSION

In the “Power supply from four different sources: Solar, Inverter, Main and Generator” has been explained in this project with all its features and details. It will enhance the productivity due to auto switching and also will increase the speed of operation so no interruption will occur. The significance of this project lies in its various advantages and wide places of applications such as Industries, Hospitals, Bank etc. It has been developed by integrating Colleges/Schools, etc. It has



been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Various types of switching techniques are also discussed in every thesis.

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