Microcontroller based Automatic Power Change over Mechanism

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Abstract - *Electricity is lifeline of any country and its continuous availability at minimum cost ensure the country's growth. Reducing the burden over the energy resources leads to the use of alternative sources of energy like Solar, Wind etc. also they are available free of cost. So modern industries and homes, to ensure regular power supply incorporates mainly three sources of energy i.e. Solar, Mains (Utility grid), Diesel generator sets. So an automatic phase selector circuit is required for the switching between these supplies with the Solar having the highest priority followed by Mains for having access of cheapest electricity. The circuit make use of Transformer, Rectifier, Regulator, Comparator and Relays. The switching time is reduced considerably due to the use of high speed electronics devices.*

Key Words: Bridge Rectifier, Cost, Mains, Op-amp, Relays, Solar, Transformer.

1. INTRODUCTION

Economic development of any country depends on Electrical energy. But in most countries, the supply of this electricity for developmental purposes is very unstable. For this reasons most organizations and industries seek for alternative sources of power supply to meet up with the energy demands of the consumers. The problem encountered after seeking this alternative is the gap of time in switching from public power source to another source (standby generator). Researchers then employed the use of change over-switch in order to eliminate the gap of time for switching.

The need for steady source of power has called for alternative source of power especially in Nigeria where power failure is no surprise. The introduction of these alternative sources of supply bring forth the challenge of switching smoothly and timely between the mains supply and the alternative sources whenever there is power failure. There is also the need to reduce drudgery from switching between the two sources on the human side. Solving these challenges forms the focus of thi swork. The automatic power change-overs witch is a device that links the load and mains supply or the alternative supply together. This enables the use of either the mains supply or an alternative source when there is outage on the mains source. This can either come in with three phase or single phase. This device maintains constant power supply to the load by automatically activating the generator when there is need. Reliable and secure uninterruptible power supply is the hope of all industrial operations, especially in most developing countries where population growth, industrialization and urbanization, T. Ilomuanya, Department of Industrial Physics, Chukwuemeka Odumegwu Ojukwu University, Uli, Anambra State, Nigeria. U.V. OKPALA., Department of Industrial Physics, Chukwuemeka Odumegwu Ojukwu University, Uli, Anambra State, Nigeria. and improper planning by service providers and governments are the order of the day.

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.

In view of the inherent features of the switching device, this paper presents the design and construction of an automatic changeover, which switches electrical power supply from public supply to generator, in the event of power outage. The system uses an electronic control circuit involving integrated circuits, transistors and electromechanical devices. The generator delay will help protect both the generating set and the appliances; a delay circuit allows the generator to run to full load, before connecting the load to it. The power indicator on the other hand gives the operator both visual and audio indication, when the public power is restored thereby reducing cost of power as it is cheaper to run on public power supply.

There are basically three types of changeover switches based on the design and mode of operation namely: manual changeover, electrical changeover and electronic changeover. Manual changeover is the most popular changeover switch in use. Manual change-over switch consists of a manual change over switch box, switch gear box and cutout fuse or the connector fuse (Rockis & Mazur, 2001). This change-over switch box separates the source between the generator and public supply (Ahmed, et al., 2006). The contact is manually switched from mains terminal to the generator terminal and vice-versa. The major drawbacks are that firstly, it requires a lot of human action to operate and also the ceramic insulator can crack during switching and lead to electric shock if the contact wire touches the metal casing. Secondly, it has led to several deaths and damage to electrical appliances (Emerole, et al.,

2015). Rapid wear and tear of the mechanical parts also occurs due to continuous up and down movement which will lead to increased frequent maintenance.

2. BLOCK DIAGRAM

The power supply unit consists of step-down transformer, rectifier (full wave bridge) filter capacitor and voltage regulator. It converts high ac input to a ripple free regulated d. c. power which powers the relay, logic gate and alarm units, in carrying out their various functions. In the design, we are converting 220V (a. c.) at 50Hz to 12V d .c. regulated power.
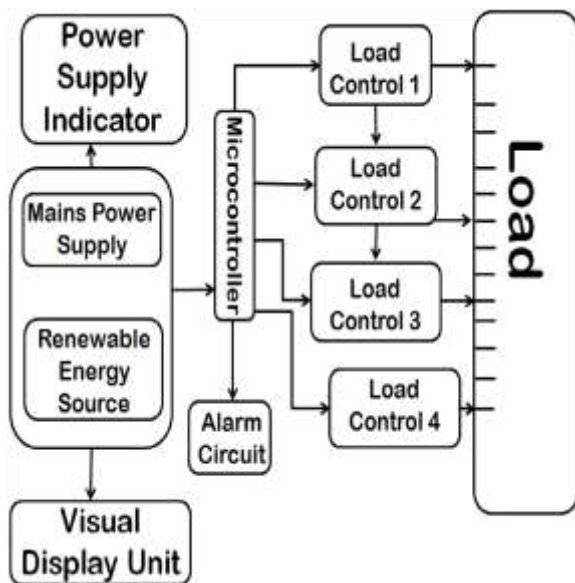

Fig. 2.1: Block Diagram of Proposed System

After careful calculation and selection of components, the circuit diagram was drawn in Proteus. It was then assembled and implemented block-by-block on a breadboard, tested and found to perform satisfactorily. Before transferring the separate blocks/units to a Vero board for careful soldering and testing microcontroller unit circuit is the heart universal programmer, respectively. This is where the program for circuit diagram is as shown in Fig. 2.1 the control part of the paper is written and burned using assembly language and a The 8052 microcontroller hardware circuit is usually a very flexible one and all the surrounding components are given a recommended range of values, by the datasheet but the actual values can be chosen by the programmer.

3. METHODOLOGY

In this paper is aimed at designing and constructing an automatic change over with step loader. Under normal operation, the circuit is programmed to change over power supply from the generator to the mains supply and back to the generator (the generator is sequentially loaded) when

there is no supply from the mains. Series of programs were written in assembly language and were embedded into the microcontroller. As regards the power supply unit, transformer TR1 steps down the voltage to 12V, then bridge rectifier BR1 rectifies it to pulsating dc, and then capacitor C1 does the filtering and inputs it to the voltage regulator LM 7805 to give a fixed output of purer dc power which power the microcontroller U3 and display unit at 5V; or LM7812 to power the relays at 12V.

There are two alarms, one sounds when there is utility power restoration (in the beginning of the circuit when you turn it ON, when power goes out and when power comes back) and the other alarm is called an error alarm sounds when the system deviates from its usual or defined pattern e.g. when the generator refuses to start or stop. The alarm circuit comprises audio (buzzer) BUZ1 and visual (LED) D3 indicators driven by a 555 timer U6 connected in astable mode. In this mode it has no stable state. The 555timer produces a square wave (pulsating or intermittent signal) and its output continually switches state between high and low without any intervention from the user. As stated already, when there is the presence of power from the mains supply, the NOT gate D5A sends a low signal to the microcontroller U3 which will in turn send a low signal to the 555 timer (U6) connected in an astable mode, which produces a signal of alternating pulses with a 50% duty cycle, which triggers the buzzer to output a constant pulsating alarm and flashes the LED D3 on and off.

The input voltage from the backup battery gives us a maximum of 8V and the capacitor could make the voltage going into the regulator to get up to 15V. This value is typical for the 7805 regulator, as the maximum required voltage input is about 25V. The 7805 voltage regulator is a three terminal IC used for voltage regulation. It is factory trimmed to provide a fixed output of 5 volts at 1A load current and has an on chip circuitry to prevent damage in the event of over heat or excessive load current. The chip simply shuts down, rather than burning out.

The Power supply unit is responsible for supplying the system's power requirements. It makes power available to the other units of the hardware system. The Power supply unit delivers 5V dc regulated supply at 1A each.

The paper 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

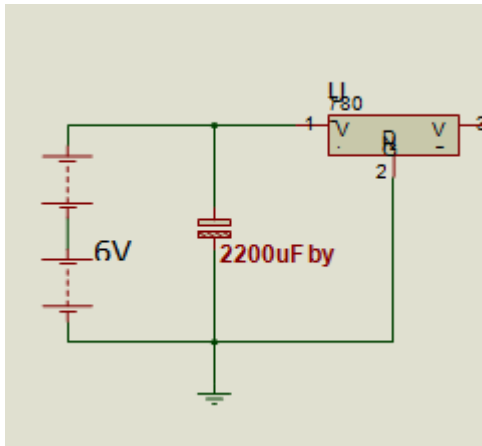next one is used and so on. An LCD is also used to display which source is being currently used for power supply.

Fig 3: The Power Supply Unit.

3.1 Advantages

i.   The time required of switching between the phases have been drastically reduced.
ii. More automatic operation with the elimination of selector switch.
iii. Reduced circuit size and easier implementation
iv. The problem of unwanted rotation of gear motor does not arise.
v.   The problem of sparking between the selector switch and the phase connection does not arise.
vi. Highly sensitive
vii. Works according to the phase availability
viii. Low cost and reliable circuit
ix. Complete elimination of manpower
x.   Can handle heavy loads

3.2 Application

i.   Hostels and Hotels
ii. Hospitals
iii. Colleges
iv. Offices
v.   Industries

4. CONCLUSION

We have successfully constructed microcontroller-based automatic power changeover with artificial intelligence for auto switching from conventional source to alternative source and vice versa, in the event of power failure. This system has two major sensors; one for the public power supply and the other for the standby generator. The signal from the sensor goes through signal conditioning to be able to communicate with the controller. The system is cheap, portable, durable and reliable and can be used in houses, offices, industrial settings and all environments where constant 3 phase supply are of great importance.

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