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RESEARCH ARTICLE OPEN ACCESS

AUTOMATIC CHANGEOVER SYSTEM WITH SMS CONTROL

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Abstract:

The main aim of any electrical power supply is to supply uninterrupted power supply to all its consumers at all time. Although, in some developing countries, the electric power generated is to satisfy the growing consumers, hence power instability and outage. This paper is an implementation of an automatic changeover switch with Short Message service (sms) control. This suggests that when there's any mains failure, the automated changeover switch will change to an alternate power supply (Generator), and back to the main supply when it is restored, notifying the user of the occurrences and the user interfere by texting "Stop" or "Start" to the device which the generator will respond to as stop or start. This device profound solution to frequent power interruption and the ever presence of a user to manually switch power When the power failure occurs this system will send one SMS to the user. "POWER is OFF". If loads get the power from main means the SMS is send as "MAIN POWER is ON". Generator set can be controlled (ON and OFF) simply by sending sms.

Keywords:- **Automatic, SMS, Power, Switching, Mains supply, Generator**

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I. INTRODUCTION

The need for continuous power supply and its reliability has increased rapidly over the years, especially altogether those areas where uninterrupted power supply may be a must. Modern systems are power dependent. Their complexity has increased as continuous information and communications are needed to regulate automated process, be in industries, commercial complexes, hospitals, hotels or maybe modern residences. The need, as such, for independent standby power grid has therefore increased manifold. the facility distribution, control, monitoring and protection of standby power systems got to be integrated. Standby generator systems, for instance are required to serve:-

In the event of power outage, the standby power is typically expected to require over automatically. Electrical starting equipment, battery bank and diesel generator are required for the automatic operation. The automatic transfer is achieved mostly by automatic mains failure systems. The process of on-load transfer need to be monitored and controlled for a smooth transfer and within safety limits of all elements of the

system. This is achieved by an Automatic Changeover Switch with sms controlled

Changeover switches find a wide range of application wherever the reliability of electricity supply is low and they are used in lighting circuit, motor circuits etc wherever continuity of supply is necessary, for switching to an alternate source from mains supply and the other way around . They are switch dis-connectors with independent manual operation capable of making, carrying and breaking currents under normal circuit conditions which may include operating overload conditions and also carrying currents under specified abnormal circuit conditions like those of short for a specified time.

Automatic changeover switch (also referred to as automatic transfer switch ATS) is an integral a part of an electricity generation process, allowing smooth and immediate transfer of electrical current between multiple sources and load. When the generator is operational , the transfer switch prevents any feedback current to the load. It also ensures that the various power sources are synchronized before the load is transferred to them. The transfer switch senses when there's interruption if the mains supply remains absent. Fluctuations and drop below a specific level within a specified time within the mains supply also will cause the automated transfer switch to transfer the load to the generator. The starting of the generator is completed by a relay which switches the battery voltage to the induction coil of the generator. In a few seconds when the generator is producing full power, the transfer switch disconnects the load from the mains supply and connects it to the generator supply, restoring electricity to the load. The transfer switch continues to watch the mains supply and when it's restored, it switches the load from the generator back to the mains supply, thereby disconnecting the generator from the load and when the generator sense no load it will shuts down automatically. The user is usually notify by means of short message service (SMS) and power can be turn OFF or ON by SMS as well.

A. Justification

The only solution to the problems of manual switching of generator and the changeover is to design an automatic system that will be able to sense the absence of the mains supply, start the generator and engage the generator with the load through the changeover. Furthermore, the system should be able to stop the generator as soon as the mains supply is restored and switch the changeover to the supply, hence the need for this project.

B. Related Works

The related research works are not limited to:

a. Design and Implementation of a 3-Phase Automatic Power Change-over Switch (Newton, Roy & Solomon, 2014). The paper deals with the design and development of 3-phase automatic changeover. The authors designed a system that could detect phase failure and automatically select and switch to a phase that has supply.

b. Design and Simulation of Microcontroller Based Electronic Calendar Using Multisim Circuit Design Software, (Ezeofor & Okafor, 2014). They were able to simulate the use of microcontroller in the development of electronic calendar.

c. Construction of Microcontroller Based Digital Voltmeter (Jony & Rahman, 2014). In their study, the authors developed a digital voltmeter using PIC microcontroller that could measure and display up to 220 V on a 7-segment.

The work according to Agbetuyi *et al.* (2011) however attempted to solve the problem with the manual changeover between the public supply and the secondary supply with an automatic changeover.

Automatic power changeover, according to Roy, Newton and Solomon (2014), is meant to identify fluctuation on the public supply line, start the generator and switch the load to the generator's output. It is also meant to identify when power is restored on the public supply line again, switch to it and turn off the generator.

Yet again, some problems are being envisaged with the performance of the automatic power changeover. Users of the automatic power changeover may want to regulate the use of the generator based on some

conditions, such as how long the generator should stay on and what time of the day the generator should be used or not used. In places where power outage lasts for a long time (days or weeks), this becomes necessary in order to limit the utilizations of the generator's utilities like fuel and reduce maintenance cost.

Hence the concept of the implementation of automatic changeover system with sms is presented in this paper. This aims to use the power of microcontroller in the design of control logic that will perform the duties of detecting power failure, switch between lines and also provide the programmability functionality by deploying the input/output and storage feature of the microcontroller.

C. Methodology

The methodology adopted for this research paper is the top-down method. Here, the implementation of the system started from the sensors, then the signal conditioning and analog to digital conversion subsystem, and thereafter the control system, down to the output interfaces.

On the other hand, the methodology adopted for the software development is the pseudo coding and flow chart development. The desired action expected to be performed by the control system is carefully represent by our control algorithm also called pseudo codes and the flow chart. The software controls the overall operation of the system. In this work, C programming language was used.

D. Block Diagram

The block diagram is shown in Fig 1.0. It is made up of ten blocks namely; the mains supply, sensor, starter, generator feedback, microcontroller, generator ignition, switching unit, GSM unit, change over and the load. The functions of these blocks are described below.

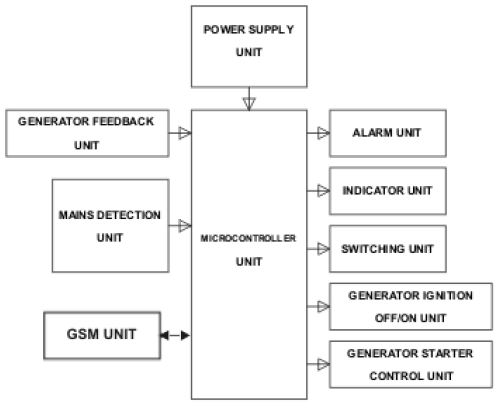

Fig.1.0: Block diagram of Automatic changeover using SMS

II. SYSTEM DEVELOPMENT DESIGN

Calculation of Power for a Three Phase System

If the changeover is to be applied on a 220V/415V,12KVA generator operating at 50Hz and a power factor of about 0.8.

To determine rating of contactor to be used as well as cable size

Recall

Apparent powers = 12 x 10^3 VA (12KVA)

Line voltage = VL = 415V

Phase voltage = VsP = 240V

Active power "P" = Apparent power x power factor

= 12 x 10^3 x 0.8

= 9.6KW

Assuming a balanced load is being used,

$P = 3 I_P VP \cos \varnothing$

$9600 = 3 \times I_P \times 240 \times 0.8$

$IP = \frac{9600}{3 \times 220 \times 0.8} = 18.19A$

$I_P \approx 18.3A$

The contactor required will have a minimum current rating of 18.3A. For increased efficiency a tolerance of about +25% will be given

Thus contactor rating will be

$18.3A + \frac{(25 \times 18.3)}{100}$

$= 18.3 + 4.6$

= 22.9Amps or nearest allowable.

Ip = 18.3 deduced is current per phase. Thus any cable used should be capable of carrying about 1½ times the current. The operating environment will also play a role.

:. Required cable should carry a current of at least

18.3 + (50% x 18.3)

= 18.3 + 9.15

= 37.45Amps

However, if the operating environment is very hot, a larger cable size will be required.

A. *Implementation of Changeover Switch*

The changeover consists of a relay coupled to the collector of transistor in common emitter mode. This arrangement switches between the generator and public supply lines, making use if the normally open and normally closed terminals of the relay. The base of the transistor is connected to the microcontroller through a biasing resistor, R_b. A diode is connected across the 12v line and the collector in reversed biased mode to prevent back EMF that might be generated from the relay coil. The circuit is shown in fig. 5 below. $V_{CE} = 0$ v when the transistor is saturated. V_{BE} = 0.6v (silicon), Vin = 5 v (voltage from microcontroller), hfe = 100, R_C being the relay resistance is 400 Ω, load voltage is 12 v R_b is given by

$$I_C = \frac{V_{Load} - V_{CE}}{R_C}$$

$$hfe = \frac{I_C}{I_B}$$

$$\therefore hfe = \frac{V_{Load} - V_{CE}}{R_C I_B} \quad (3)$$

$$I_B = \frac{V_{in} - V_{BE}}{R_C}$$

$$R_b = \frac{hfe * R_C (V_{in} - V_{BE})}{V_{load} - V_{CE}} \quad (4)$$

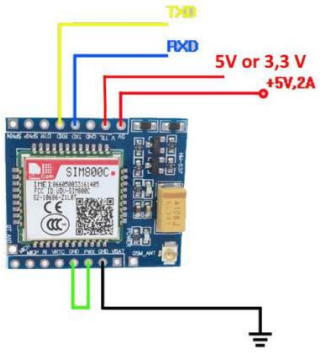

Fig.3: image of GSM Module

Here are the features of the SIM800L breakout board:

- 2G quad-band @ 850/900/1800/1900 MHz
- Receive and make calls using the speaker and microphone outputs
- Receive and send SMS
- Connect to the Internet via GPRS
- Listen to FM radio broadcasts
- Accepts AT Commands

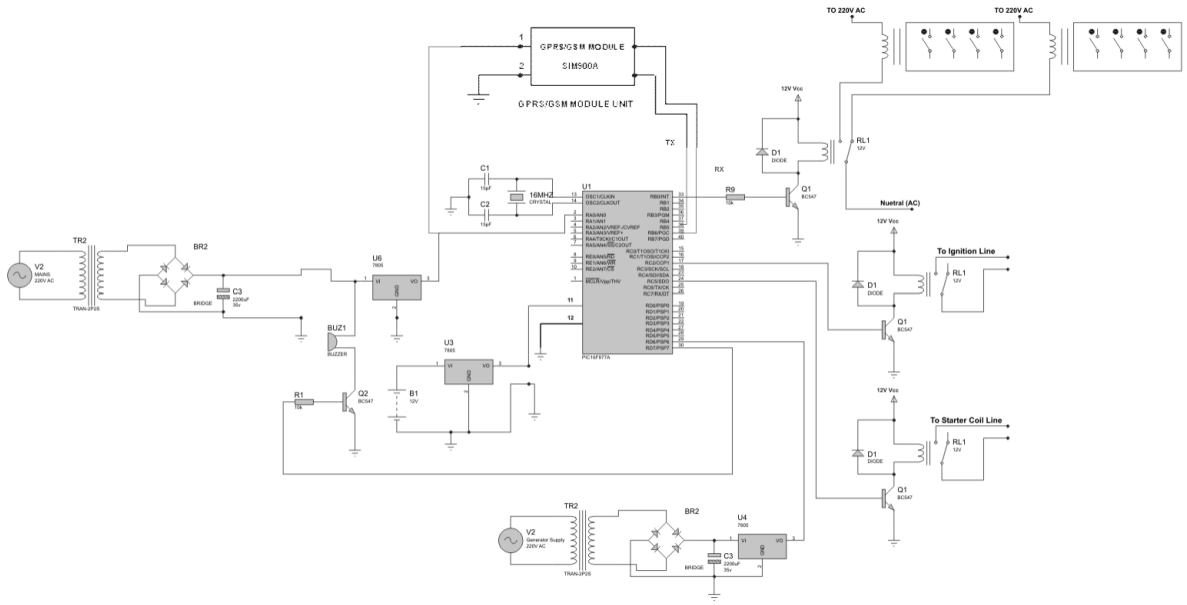

Fig.2.0: Circuit Diagram of Automatic Changeover System with SMS Control

III. SOFTWARE SUBSYSTEM IMPLEMENTATION

Various implementations of design steps ensured that software system was properly integrated with my hardware. This resulted into software codes that are working properly. These steps are;

(1) Initialization and Port/ bits assignments
(2) Writing of the main or control program
(3) Writing of required subroutines
(4) Assembling the Assembly language codes
(5) Programming the HEX file of the assembled assembly language codes
(6) Test Running the Program Controller inside the Hardware.

I assigned all my output bits and feedback bit and initialized them to state zero.

Writing of the Main Program

The main program for the system was written using the control algorithm realized during the design stage. The program is written with the instruction set 8051series of microcontroller. The main program needs some subprograms to run, these subprograms are called subroutines. Example of a subprogram is the delay subroutine. The main program often calls the subroutine, which executes and returns back to the main program after execution.

V. RESULT

The system circuit was implemented and tested by passing biasing voltage to the base of the transistor to ensure that the relay was switching fine. The last stage of the implementation was to burn the c program into the microcontroller. The code was tested and debugged. The routine of testing and debugging continued until the system perfumed as expected. When the system was connected to a generator set with start switch and a 240 V AC

mains supply. Result showed that in the absence of mains supply the system will start the generator and automatically changed over to the generator line. SMS is receive whenever there is mains failure or ON and the user can send a command to changeover power via sms as well.

VI. CONCLUSIONS

The design and implementation of programmable power changeover has been implemented in this paper. The technology will upon the automation of the existing change over system, add some intelligence to automatic power changeover by allowing user to choose the mode they want their automatic systems to operate on.

ACKNOWLEDGMENT

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