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Design and Implementation of an Android Based Automatic Phase Selector and Overload Protector Using GSM

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Abstract: *In this century, the demand for electricity is increasing at an alarming rate that has caused pressure on the existing transmission and distribution networks. This has led to power cuts affecting sensitive facilities such as hospitals, industries and schools. This project is designed to automatically supply continuous power to the load through one or all of the three sources of supply that are: solar, mains grid & generator. In case their availability; an android app is used to select the source of choice and when the amount of load demand increases beyond what can be handled by one source, a mobile app is used to bring on board either of the remaining two sources so as to meet the load demand. The output of either source is connected to a voltage stabilizer which stabilizes the voltage to 220Vac by means of an auto-transformer with many taps and then the load is connected through an overload protector circuit which monitors the amount of current drawn. Once the current exceeds normal values, the last load connected is automatically isolated from the source leaving the critical loads connected. At the same time a message is sent to the operator by means of GSM, notifying of the overload. The operator can decide to operate the loads by sending a text message "normal" to restore the system operation to use an android app.*

Keywords: Automatic phase selector, voltage stabilizer, overload protector, android app, current sensors, Bluetooth, GSM module (Text message option) & automation.

1. INTRODUCTION

An automatic phase selector and overload protector is an electrical device that is capable of transferring a load from one source of power supply to another and to bring on board all or some sources in case one source is incapable of supplying the load. The basic function of a phase selector switch is to make and break from one source of power supply to another or bring all sources on broad in case one source is incapable to supply the entire load. It can also serve to stabilize power sources in the event of under voltage, overvoltage thus preventing voltage surge and overload protection thereby, protecting the source from over drain especially when using battery bank. A manual operation of transfer switch requires the availability of electrical personnel to operate the switch. Thus, it cannot be used in some industrial and commercial applications where absence of power for a certain period of time could have serious implications in terms of life, financial losses due to loss of production, data storage and products. In order to eliminate the time delay between changing over from one source to another, and outage of power due to voltage variation, there is therefore a need for a phase selector with voltage stabilizer and overload protection. [4] An automatic phase selector (APS) serves as an interface between power sources in order to maintain a continuous supply of electricity to the load. The selector automatically senses the power failure from solar power, and supplies the load with either grid or generator for startup. The phase selector will continue to monitor the condition of the solar power source until it is restored. Also in the event of voltage variation and overload, this device will protect both the consumers and producers equipment.

2.0 SYSTEM DESCRIPTION

An android based automatic phase selector and overload protector with a build voltage stabilizer is an electrical and electronics based project consisting of different components. The Bluetooth module H5-5A is used to connect the android app in the phone with the system such that switching of loads and different sources can be achieved. GSM SIM900A is an open and digital cellular technology used for transmitting mobile voice and data services and operates at 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. The data transmitted in this project is text based. Acs712 is Hall Effect based current sensor which can measure both direct current and alternating current. In this case the sensor is connected with an alternating current to measure the current drawn by the load and it is connected in series with the load. ATMEGA328P is high performance, low power controller from Microchip. ATMEGA328P is an 8-bit microcontroller based on AVR RISC architecture and it is used in ARDUINO boards. This chip is the brain of the system which monitors the parameters and does the computation which is transmitted by all the field devices. The microchip then actuates the relays to their appropriate operations depending on the input parameters of the sensors.

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Picture 1: Automatic phase selector and overload protector implementation

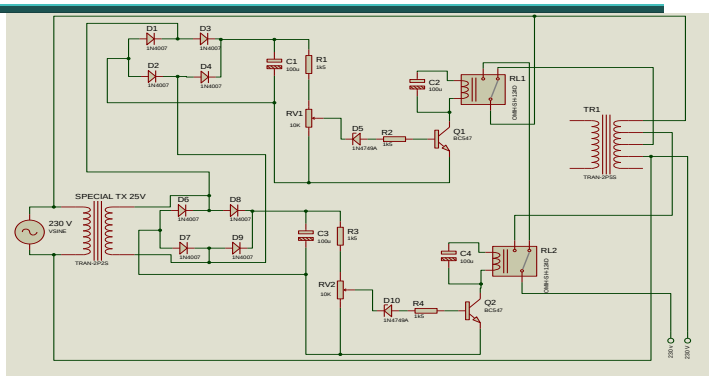

Figure 3: Circuit diagram of an automatic voltage stabilizer

Block Diagram of the System

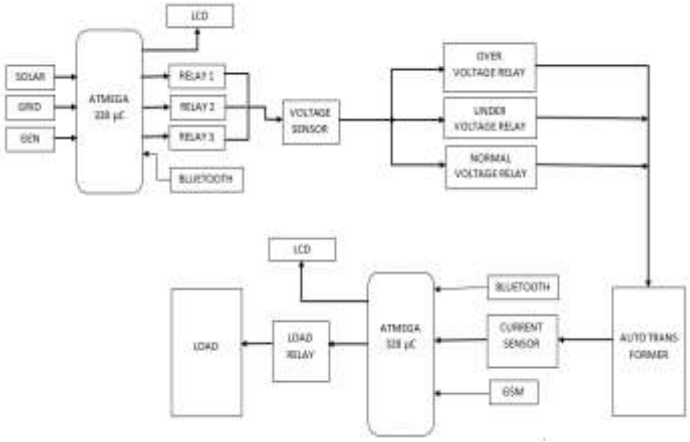

Figure 1: Block diagram of Automatic phase selector and voltage-Overload protection

Automatic Overload Protector circuit

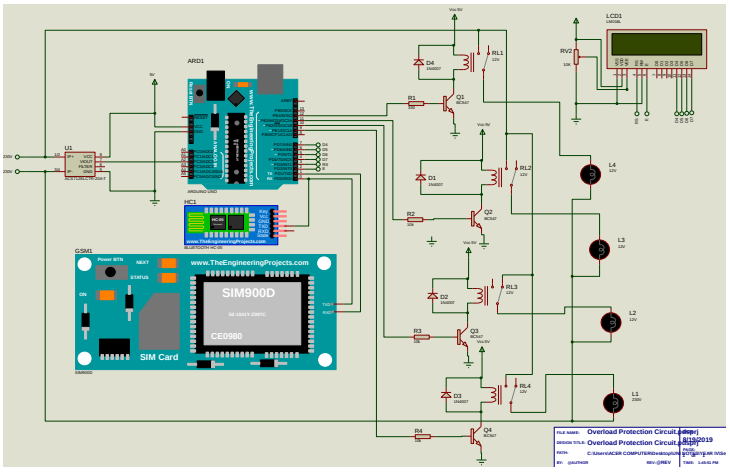

Figure 4: Circuit diagram of an automatic overload protector

An Automatic Phase Selector Circuit

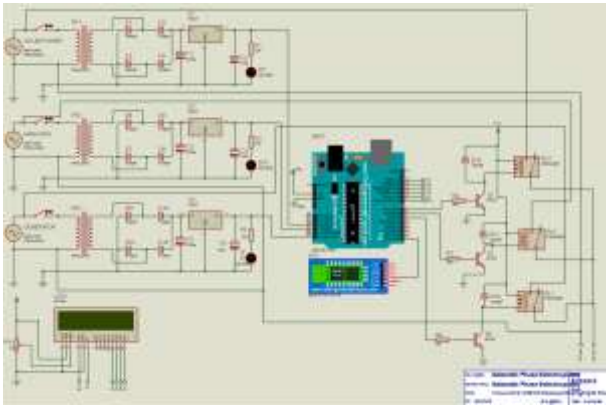

Figure 2: Circuit for Automatic Phase Selector Automatic

Power Supply Circuit

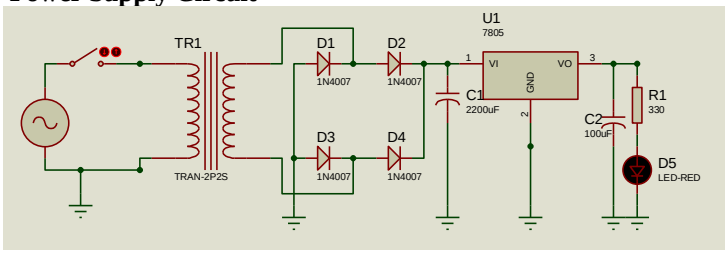

Figure 5: Regulated power supply circuit

Voltage Stabilizer circuit

3.0 Logic design

The project basically supplies continuous power to a load in an automated mode through one of the three sources of supply that are: solar, main grid and generator when any one of them is available.

Three power supplies connected to three different socket outlets are used for three respective sources. The output of these three power supplies is connected to the Atmega 328P microcontroller and they act as sensors to the analog input to the microcontroller. When a socket outlet is turned on, a

240Vac is stepped down to 14Vac which is rectified and regulated to 5Vdc. This regulated voltage acts as an input to the microcontroller. Once there is an input of 5Vdc to the analog terminal of the microcontroller, a relay switch is turned on to supply the load with an AC voltage. Lamps rated 100W were used as a load for demonstration purpose which draws power from the main. The output of the ATS is then connected to the voltage regulation circuit which has an in build voltage sensor to detect under or overvoltage. In case of any variation in the supply, the sensor will activate the responsible relay to select an appropriate tap on the auto-transformer thus maintaining a constant output voltage. From the voltage regulating circuit, a load is connected through an overload protection system. This will isolate the load from the supply in case of overload and send message to the engineer/ technician so as to control the load by mean of GSM messages.

Flow chart For Automatic phase Selector.

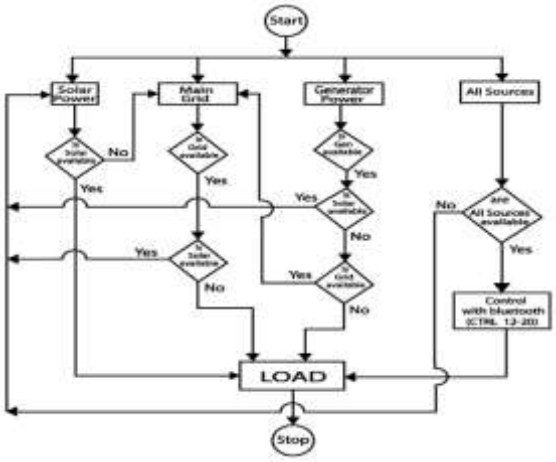

Figure 6: Flow chart for an automatic phase selector

Flow chart For Automatic voltage stabilizer.

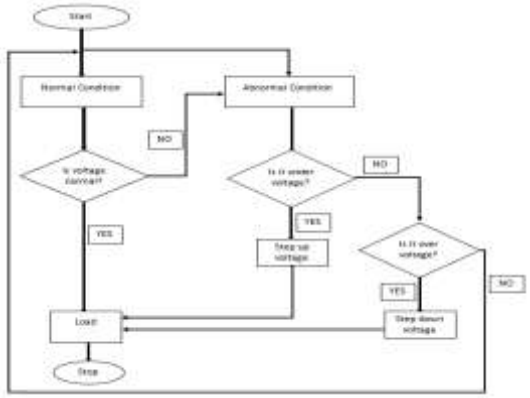

Figure 7: Flow chart For Automatic voltage stabilizer.

Flow chart For Automatic overload protector.

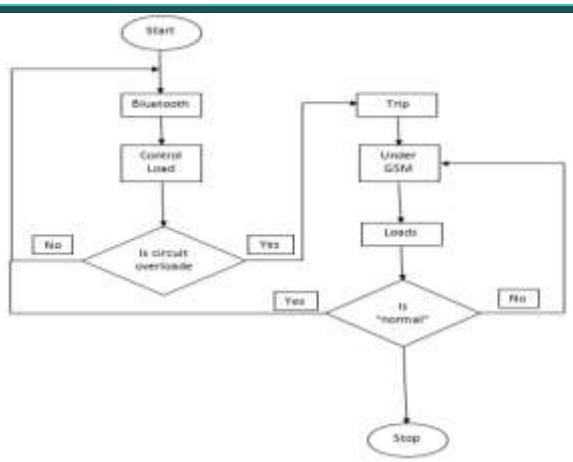

Figure 8: Flow chart For Automatic overload protector.

4.0. RESULTS AND DISCUSSION

4.1 RESULTS

4.1.1 DC power supply

Output of the bridge rectifier	Input into the voltage regulator	Output of voltage regulator	Input into the microcontroller (Vcc)
13.7Vdc	13.7Vdc	4.96Vdc	4.96Vdc

Table 1: showing results of DC power supply circuit and microcontroller

4.1.2 Automatic Phasor Selector Controlled by Automatic Mode

Power source	Input of the power source(VAC)	Switch status	LCD Display
Solar	220V	ON	SOLAR ON
Solar	220V	OFF	SOLAR OFF
grid	220V	ON	GRID ON
grid	220V	OFF	GRID OFF
Generator	220V	ON	GENERATOR ON
Generator	220V	OFF	GENERATOR OFF
All source	220V	ON	CONTROL BY BLUETOOTH (CTRL WITH 12-20)

Table 2: showing Sources status when controlled by automatic mode.

4.1.3 Automatic Phasor Selector Controlled by Android (Bluetooth) Mode

Power source	Input of the power source(VAC)	Input to the app	Switch status	LCD Display
Solar	220V	12	ON	SOLAR ON
	220V	13	OFF	SOLAR OFF
Grid	220V	14	ON	GRID ON
	220V	15	OFF	GRID OFF
Generator	220V	16	ON	GENERATOR ON
	220V	17	OFF	GENERATOR OFF
All sources	220V	18	ON	ALL SOURCES
	220V	19	OFF	NO POWER
Automatic controlled	220V	20	ON	ANY SOURCE AVAILABLE

Table 3: Showing Sources status when controlled by Bluetooth

4.1.4 Automatic Voltage Stabilizer

Input Voltages (V)	Relays	Relay Status	Output Voltage (V)
190	Relay 1	ON	220
260	Relay 2	ON	220

Table 4: Showing status of voltage stabilizer.

4.1.5 Automatic Overload Protector Controlled Using Bluetooth

Loads	Input of the power source(VAC)	Input to the android app	Switch status	LCD Display
All Loads OFF	220V	10	OFF	CTRL WITH 1-10
Load-1	220V	1	ON	LOAD-1 ON
	220V	2	OFF	LOAD-1 OFF
Load-2	220V	3	ON	LOAD-2 ON
	220V	4	OFF	LOAD-2 OFF
Load-3	220V	5	ON	LOAD-3 ON
	220V	6	OFF	LOAD-3 OFF
Load-4	220V	7	ON	LOAD-4 ON
	220V	8	OFF	LOAD-4 OFF
All Loads ON	220v	9	ON	GSM CONTROL (circuit overloaded)

Table 5: Showing status of loads being controlled by Bluetooth

4.1.6 Automatic Overload Protector Controlled Using GSM

Loads	Input of the power source(VAC)	GSM Messages	Switch status	LCD Display
Load-1	220V	Load1_on	ON	LOAD-1 ON
	220V	Load1_off	OFF	LOAD-1 OFF
Load-2	220V	Load2_on	ON	LOAD-2 ON
	220V	Load2_off	OFF	LOAD-2 OFF
Load-3	220V	Load3_on	ON	LOAD-3 ON
	220V	Load3_off	OFF	LOAD-3 OFF
Load-4	220V	Load4_on	ON	LOAD-4 ON
	220V	Load4_off	OFF	LOAD-4 OFF
All loads on	220v	All_loads_on	ON	GSM CONTROL (OVERLOAD STATUS)
All loads off	220V	All_loads_off	OFF	ALL-LOADS-OFF
Set to Bluetooth control	220V	normal	OFF	CTRL WITH 1-10

Table 6: Showing loads status Controlled by GSM

4.3 Discussion

The prototype was implemented, tested and integrated before testing the entire system. The input from the three sources was given to the Atmega 328P microcontroller and the output of the microcontroller was given to the relay which maintains continuous power supply to the load through the voltage stabilizer and overload protector.

Finally, the system status of the available sources and load characteristic are displayed on the LCD, the following modes of operation were obtained as shown by figures below.

Picture 5: showing snapshot of the automatic phase selector powered by solar power

Picture 6: Showing snapshot of the overload system using an app (CTRL WITH 1-10)

5.0 Conclusions

This project of ***an android based automatic phase selector and overload protector using atmega 328p microcontroller and gsm*** is used to handle power supply from solar, grid and generator most effectively and to stabilize voltage to the load with an addition of overload protection.

The sequence of the project is the selection of supply from solar, main grid and generator automatically using microcontroller and android app. This project also protects the load against voltage variation and overload. This protection schemes are not found in the current developed systems, hence making APS and overload protector superior than all of them.

The significance of this project lies in the various and wide places of applications such as; power generation plants, schools, hospitals, and most especially manufacturing industries and mining industries where continuous supply of power is important.

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