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# An Automatic Load Controller for Domestic Applications

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**ABSTRACT**

This paper presents a system to avoid the procedure of load shedding. Here the relation with frequency and power is utilized. A system of automatic controlling of devices which will help us to save the power to a greater extend is proposed here. For each device connected to the system, a cutoff frequency is fixed. When the frequency of the power supply goes below this cutoff frequency, the particular device will be automatically turned off and the device will return to its normal operating condition when the frequency reaches its normal value.

***KEYWORDS:*** Load shedding, cut-off frequency, controller, blackout

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## INTRODUCTION

An intentional power outage additionally introduced to a rotational load shedding or feeder rotation is a deliberately designed power blackout where power conveyance is halted for non-overlapping period of time over various parts of the distribution area. They are a kind of demand response for a state where the demand for electricity go beyond the power supply competency of the system [1]. Rotational load shedding or basically load shedding might be confined to a particular portion of the electric system or can be more wide spread and may disturb the whole nation. Rotational load shedding is usually due to inadequate generation capacity and insufficient transmission structure to distribute sufficient power to the region wherever it is desired [2].

Load shedding is normal or might be a regular happening in several developing nations wherever electricity generation capacity is underfunded or framework is ineffectively accomplished. Load shedding is generally unusual in developed nations since demand is correctly predicted, supportable infrastructure is planned and systems are suitably accomplished [3].

In very much overseen under capacity structures, load shedding is planned in advance and acclimated to enable individuals to work around them, however in certain circumstances they occur abruptly, regularly when the transmission frequency falls underneath safe limit. This paper is aimed to introduce a system where frequency variation can cause the shutting down specific equipment one by one rather than a complete power off for a locality. Also, if in a case of emergency, this system can be switched on but for a specific time limit. This system, introduce the concept of switching off some specific domestic component which utilize more power [4]. Hence the consumption level at demand period can be decreased. Also in case of an emergency we can switch on the system for a short duration of time, where after this time the system switch off the equipment by itself. A manual switch provides energy to the system in case of an emergency, when the frequency falls below the cut off frequency. This additional energy consumption is recorded by an additional energy meter charging higher cost for each unit of power.

## LITERATURE REVIEW

There are previous works based on this concept i.e. to control the devices on comparison with the input power supply. Stabilizers are one such example. Many types of stabilizers are available to us which only avoid the damage to the system but never adds to the process of power savings. Also in the market there were previously available under voltage switching i.e. if the comparison is made in terms of voltage [5]. But it was not that successful in market due to its high cost and lack of efficiency in working. An idea of under frequency was also introduced, which is not yet implemented effectively. Hence the study was dropped [6]. And we still face the procedure of load shedding on heavy summer season, when the production of electricity becomes low and it cannot meet the growing peak demand.

This paper introduces an idea of building up a system that can avoid a complete total blackout or load shedding in future. We can proceed this work in two ways. In the initial part we deals with the control of power consumed by high power consumption devices like, air conditioner, microwave

oven, grinder, induction cooker, geyser etc. so here we check the time period of the incoming power supply by making use of a Zero Crossing Detector and then further working is controlled by a microcontroller [7]. The microcontroller convert the time period calculated to frequency and compare this frequency with the cut-off frequency and if this range of input power frequency is below the cut-off frequency of a specific machine then that particular machine gets turned off at that time. A manual switch is also provided to turn on the system in case of any emergency, but only for a short period of time. . This additional energy consumption is recorded by an additional energy meter charging higher cost for each unit of power.

**PROPOSED CIRCUIT**

**A. Block diagram**

This section deals with the block diagram of the proposed circuit given in fig 1. The circuit is intended to control the power consumption of electronic devices with respect to the variations in power demand and power availability.

As explained earlier this system controls the domestic usage of power supply by the variations in the frequency. So when the frequency fall in the lower limit that is below 48.5 Hz the system will switch off the power by itself. But in case of any emergency to use the domestic appliances a manual switch is also provided to turn on the power supply to that particular domestic devices which is being turned off due to the lower frequency in the supply power.

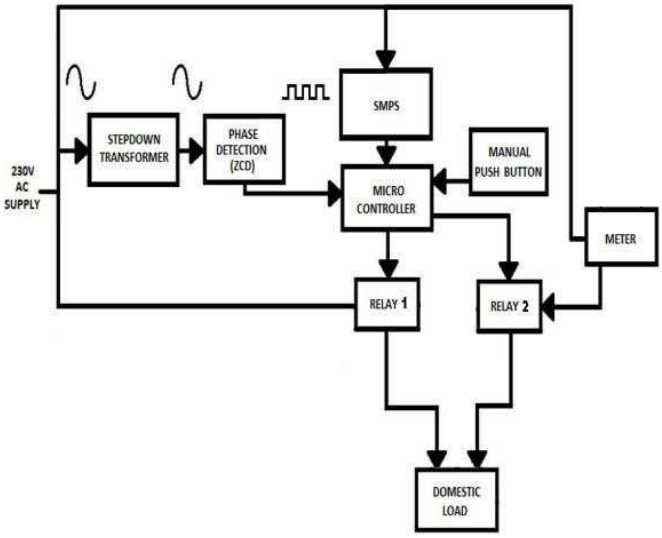


**Fig1. Block diagram of operation**

The flow chart for the main program can be depicted as in fig2

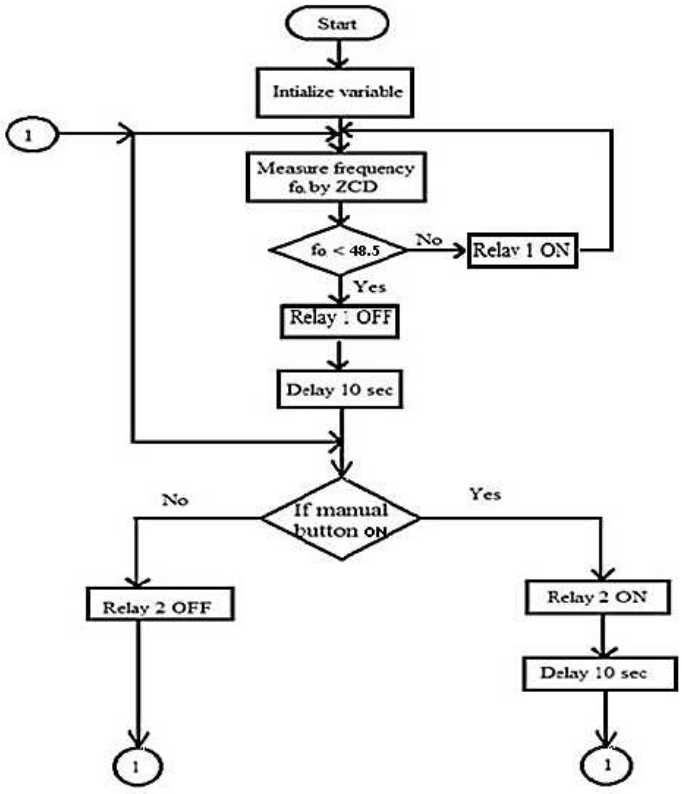


**Fig2. Flowchart of main circuit**

The additional usage of power which is once turned off by the system will recorded by an additional energy meter. Also this power consumed will be charged at a higher rate of cost for each unit consumed. Also this energy usage will be only for a fixed time after that the supply frequency will be checked again and continue the all procedure.

**B. Circuit diagram**

This section deals with the detailed description of the circuit diagram. Fig 3 shows the detailed main circuit diagram of the system.

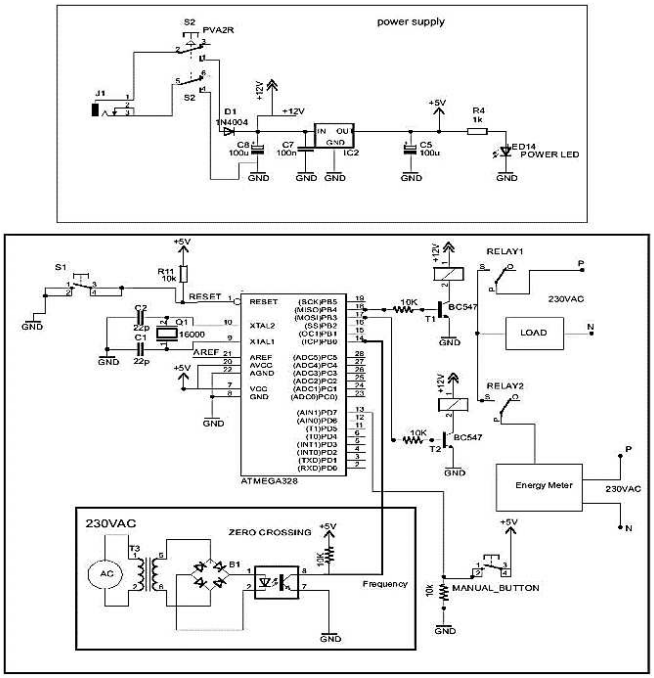


**Fig3. Circuit diagram**

The circuit description deals with three sections.

### A. Phase detection section

This section includes a zero crossing detector which detects each phase and helps in determining the time period for frequency calculation, using the relationship that frequency is inversely proportional to time period.

Here an input of 230V AC supply is given to a step down transformer to step down the voltage from 230V to 6V AC. This input is given to a bridge rectifier to rectify the input power. The output from the bridge rectifier is given to an opt coupler to calculate the time period T of the given input signal. For this here we make use of the relation;

$$f = \frac{1}{T}$$

This information is provided to the micro controller. The optocoupler along with the bridge rectifier constitutes the zero crossing detector.

### B. Micro-controller section

Microcontroller section includes programming the microcontroller in C language to convert the time period to frequency and later to check whether the frequency of incoming supply is in the safer limit or not. If the frequency is not safe then the microcontroller gives request to turn OFF the relay there by switching off the supply to domestic load.

Micro controller section consist of atmega328micro controller with various input section. Here the output from the ZCD is given to the microcontroller's fourth pin which acts as the input to the microcontroller. Microcontroller convert it to frequency and later utilizes it to compare it with a cut off frequency which we used in programming depending in the machine we used.

The output from the microcontroller is given through the thirteenth pin to an under frequency protection relay and thereby to switch off the supply to the load. A switch is connected in series to the load connected, which will help to turn on the device manually during any emergency situation if needed. Power supply to the microcontroller is provided using a Switched Mode Power Supply (SMPS).

### C. Manual button and energy meter section

Manual button is used to switch on the supply to the domestic load which is once turned off by the microcontroller section due to unsafe frequency limit. This manual button is only used in case of an emergency. Also special timer is set to turn OFF the supply to the manual button after 30 minutes of its being turned ON. An additional energy meter is also kept with it to calculate the extra energy used by switching on the manual button, with a higher rate for unit of energy consumed.

### D. Frequency generation circuit

To demonstrate the proposed system whether it is working or not, an additional frequency generator is necessary. The flow chart of frequency generation can be simplified as given below in Fig.4

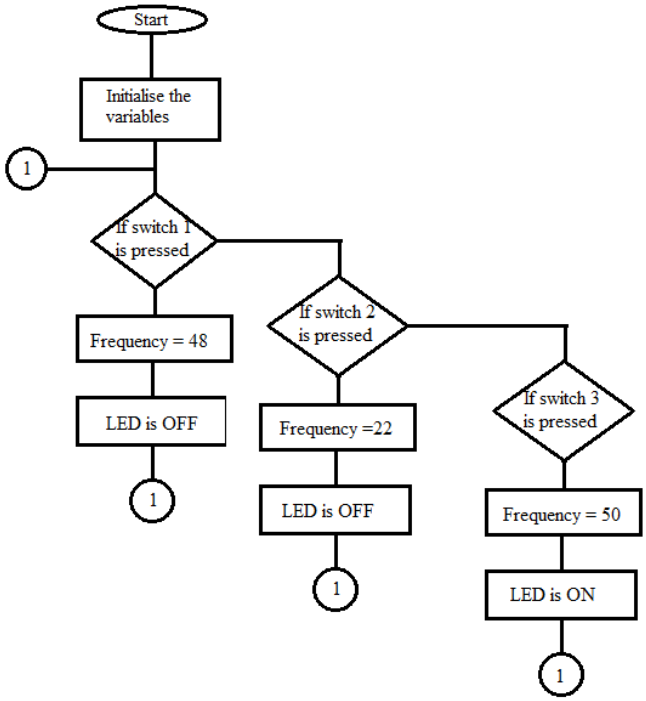


**Fig4. Flowchart of Frequency generation circuit**

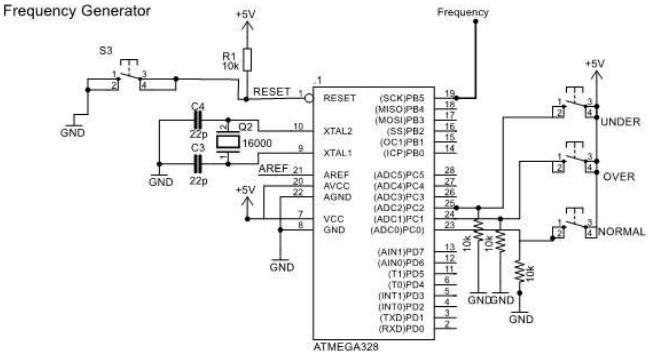


**Fig5. Frequency generation circuit diagram**

This circuit will generate three different frequencies,( a safe limit, a lower limit and an upper limit frequency) to demonstrate that the system only provide power supply in safer limits.

## HARDWARE IMPLEMENTATION

In order to verify the system a prototype was build and tested as given in Fig 6. Automatic domestic load controlling system is aimed to control the domestic load consumption automatically. Hardware system will demonstrate a system to control the energy consumed and to monitor the frequency of the supply power. Initially we calculated the frequency of the supply. Next step is to check whether the supply frequency is in the safer limits, which means the supply frequency is enough to meet the consumers need. If the supply frequency is not in the safer limit the microcontroller is so programmed to cut the supply power provided to that domestic appliances.

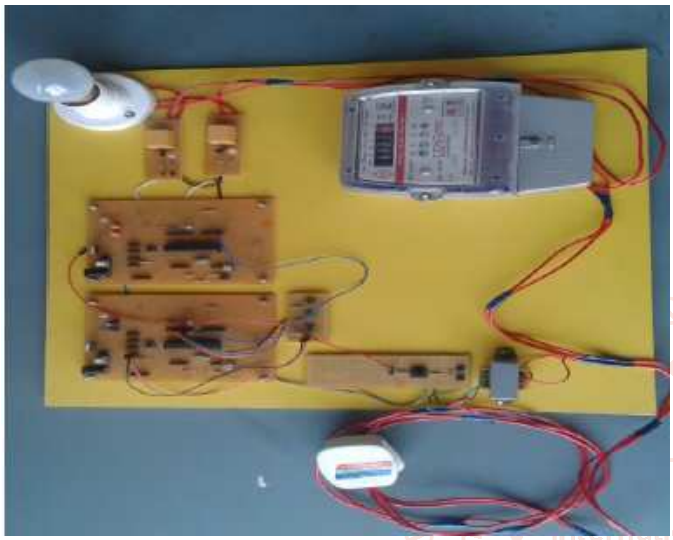

**Fig6. Prototype of proposed circuit**

Additionally a manual switch is provided to manually turn ON the supply, which is once turned OFF by the microcontroller due to unsafe frequency. But this switch is kept ON only for a time of 30 minutes, after 30 minutes this supply will be automatically turned OFF. An additional energy meter is placed to calculate the additional energy used by the consumer when the manual switch is put into the circuit, with an extra rate for the each units of energy consumed. This is exactly how the system works at the final stage of implementation.

## CONCLUSION

This paper introduces a system that differ from the other existing load shedding avoiding systems with its feature of utilizing the supply frequency to determine whether the consumption and supply is equal or not. The most interesting feature for this system is its cost of establishment and maintenance is very cheap. Hence it can be considered to be a reliable method.

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