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Design & Development of Diesel Generator Monitoring System

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ABSTRACT

In this design and development of diesel generator monitoring system, the loads which are connected to the diesel generator require more power. Therefore, overloading takes place which can damage the diesel generator and also the appliances or load that is connected to the diesel generator. Optimizing the power system in a way that it runs on a larger percentage of the rate load makes the system more effective. A monitoring system is an affordable solution to monitor power, current and voltage parameters of the generator or any other home appliances. In this system, home appliances like hair dryer, heater and bulb are used as this system is applicable only for a single-phase generator. This is carried out by connecting current and voltage sensors. This system also helps in maintenance of these attached appliances and keeps their parameters in check at all times without letting them to overload. In case these parameters are overloaded there is a good chance that the appliances will get damaged. To avoid this relay is used to switch off the system if overloaded.

KEYWORDS: stabilizer, voltage, current, power, overload, home appliances

1. INTRODUCTION

Diesel generator monitoring solution solves the on-site monitoring and multi-site maintenance requirements of business. By deploying this remote monitoring of diesel generator system, you could detect any anomaly in generator such as load, overloading, arrival of power supply [1]. In this project of diesel generator monitoring system, the parameters of the generator i.e., power, voltage and current are measured and monitored in order to avoid overloading of these parameters. These parameters of the generator will be monitored and displayed on an LCD display. If these parameters exceed the value that is set, then it will trip and the system will shut down until the parameters are back to the normal value.

The designed system is made only for single phase. Hence it can also be used to monitor other day-to-day appliances. It can also be used for stabilizer and invertor. It can be used stabilizer when there is power cut and the voltage dips which can impact the power used by the appliances connected to stabilizer and that affects the appliances badly and this may affect the working of appliances [5]. It protects the appliances by keeping the constant voltage supply without any distortion and fluctuations in the voltage. Such solution for monitoring of these appliances allows ensuring smooth operation, reducing operation costs and preventing appliances service outage, thus extending its life cycle. Various home or office appliances can be used for this system to stabilize for smooth operation. Places where this system is useful are servicing companies engaged in maintenance and repairs of diesel generators, diagnostics of domestic appliances, monitoring of time of operation, on time servicing and replacement of appliances, remote monitoring of operation of generators and appliances, engine health monitoring and overall generator diagnostics, gathering failure statistics, planning adjustments to genset design.

This designed controlled voltage stabilizer is to protect domestic appliances from voltage dips in electrical power distribution. Voltage dips affect the power quality and can have a negative impact on the proper functioning of domestic appliances and other sensitive electronic equipment. Results from the ready system confirm the effectiveness and robustness of the proposed stabilizer. Furthermore, it enables the protection of appliances by keeping the voltage level stable within a specified range around the expected value regardless of voltage fluctuation. Remote supervision of operation of diesel generator management is basically getting data for accounting and predictive maintenance [8].

2. LITERATURE SURVEY

The author shows how to design and build an energy meter using an Arduino microcontroller that can track any electrical device's power consumption [1]. An Automatic Power Factor Correction (APFC) Unit is described, which can automatically monitor a system's energy consumption and optimize its power factor. The APFC device evaluates the reactive power consumed by a system's inductive load and uses capacitance from a capacitor bank to adjust for the trailing power factor [3].

It represents the working of a smart energy system that controls and monitors the electricity through Raspberry Pi. The system lets the user control the electricity usage hence, optimizing the use of electricity [4]. The authors used an Arduino microcontroller and a GSM (Global System for Mobile Communication) module to extend the design and execution of an energy monitoring system to incorporate power agenda pre-indication. Through an Android application, the monitoring system allows users to keep track of their expenses and electricity usage [6]. They use an Arduino microcontroller, ZMPT101B voltage sensor, ACS712 current sensor, and Node MCU. Smart Grid system in which it measures all the parameter of energy of the Grid. In this voltage is measured by the system and send through the application using the GSM module [7].

3. METHDOLOGY

In this project, Arduino ATMEGA 328, voltage sensor ZMPT101B, current sensor ACS712, 20x4 I2C display, voltage regulator and relay is used. ACS712 provides solutions for AC or DC current sensing. Current sensor ACS712 is used to measure and sense the current which has been used the load. The specification of ACS712 is maximum current measure by the sensor is 30A. Voltage ZMPT101B sensor has been used in the project to measure the AC voltage which has been used by the load. When there is power cut and power is supplied by the diesel generator, the ZMPT101B sensor is connected and then measures the voltage continuously. ATMEGA 328P is an 8 bit, low-power CMOS microcontroller based on RISC Architecture. The on-chip flash of this microcontroller allows program memory to be reprogrammed in system through serial interface. A 20*4 I2C Display is used to constantly monitor the current, voltage and power limits the given load. It consists of only 4 pins out of which 2 (SDA, SCL) are used to connect the display and the other two are GND and VCC.

Power, voltage and current is monitored from the appliances which are sensed using ACS712 and ZMPT101B. This data is given to the microcontroller Arduino ATMEGA 328 which is connected to the display. The I2C Display displays the input sensed by the voltage and current sensors and calculates power using its formula.

To find power (P),

$$Power = V * I \qquad (1)$$

Where, V= voltage (Volts)
I= current (Ampere)

The SI unit of this power formula is Watt (W).

The appliances used are hairdryer, heater and a bulb. The current and voltage limiting values of these appliances are set in such a way that the hair dryer requires maximum energy and blub requires the least energy. That it is how the voltage, power and current fluctuations are noticed and these appliances are shut off as the current limit increases gradually.

4. IMPLEMENTATION

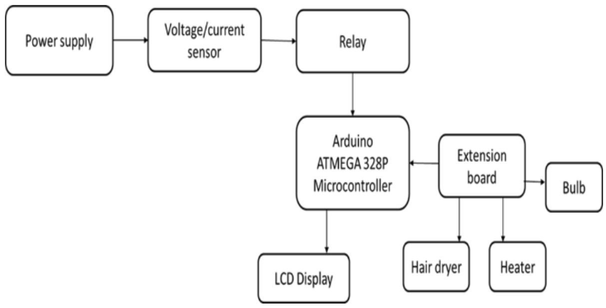

Fig. 1. Block diagram

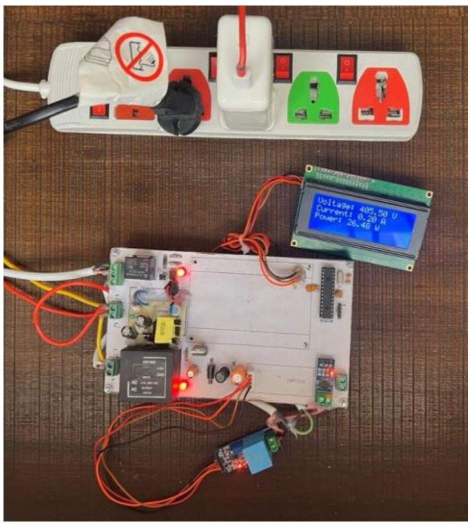

Fig. 2. Hardware

The system consists of sensors like voltage sensor ZMPT101B and current sensor ACS712, relay driver, microcontroller like ATMEGA 328P, 20x4 I2C LCD display.

The design and selection procedure of system was according to the requirement of the system. Voltage sensor used can take up to 230V- 280V. The current sensor used can take up to 30 Amperes. This limit of current sensor is used for the three output devices used namely, hair dryer, heater and bulb. Different number of current sensors can be used if appliances of higher current rating are used. For this system one current sensor with 30 A is sufficient. The input from the voltage and current sensor is given to the relay that avoids any electromagnetic interference. Arduino microcontroller is known for its user-friendly experiences. ATMega 328P is used for this purpose that forwards the sensor data to the LCD that displays current and voltage readings. These current and voltage readings help to find the power readings. The extension board and has appliances connected and are turned on as soon as they are provided with power and turned off when the current ratings of these appliances are overloaded. Once overloaded it takes up to 5 seconds to stabilize the appliances and only once they are completely stabilized they get turned on again.

6. RESULTS AND DISCUSSION

Table 1, table 2 and table 3 displayed various readings of the appliances used at three different hours of time. They show the expected value that is given on the description manual that comes along the appliances and the measured values show the readings taken during the execution of the system.

First, the bulb overloads and shuts off followed with heater and then hair dryer. All these are restarted once they are stabilized. The maximum current range for all three appliances is set to 0- 24A. The time taken by these appliances to turn back on once the overload in stabilized is set to 5 seconds.

Table 1. At time instant t1

	Bulb	Heater	Hair dryer
Expected voltage	80-265V	230V	120-240V
Measured voltage	97V	220V	193V
Expected power	12W	100-500W	100-2500W
Measured power	11W	450W	2100W

Table 2. At time instant t2

	Bulb	Heater	Hair dryer
Expected voltage	80-265V	230V	120-240V
Measured voltage	100V	230V	200V
Expected power	12W	100-500W	100-2500W
Measured power	11.4W	400W	2200W

Table 3. At time instant t3

	Bulb	Heater	Hair dryer
Expected voltage	80-265V	230V	120-240V
Measured voltage	125V	220V	193V
Expected power	12W	100-500W	100-2500W
Measured power	12W	445W	2115W

*The measured values are fluctuating and can vary.

7. CONCLUSION

The designed system is made only for single phase diesel generator. Hence it can also be used to monitor other day-to-day appliances and stabilize them. As the result tables show the different measured values of heater, hair dryer and bulb at different time instants, it is concluded that if these measured parameters exceed its expected value, then the system trips and the overloaded appliances shut down until they are stabilized.

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