Biogradable Electric Power for Off-grid Farm Settlements

[1]Aiyelabowo O. Peter and [2]Ojo B. Adelaja
[1,2]Department of Electrical/Electronics Engineering, Federal Polytechnic, Ilaro, Ogun State, Nigeria.
peter.aiyelabowo@federalpolyilaro.edu.ng

Introduction

Food is life, as it provides the energy that the body needs (Aree, et al., 2010). Food is the fuel that drives the survival of humans. The two known sources of food are plants and animals. A large percentage of the food consumed comes from plants, trees, crops, bushes, leaves and sometimes, even roots.

Nigeria has a vast potential in Agriculture owing to her land size, spanning about 923,768 sqkm. But her agricultural output is meagre compared to her capacity. This is because most of her population practices farming on peasant basis.Mechanization is required for large scale farm yield (Thomas, et al., 2020). Farm mechanization is the deployment machineries, tools, and technology for farming activities in order to substitute for the labour of human and animal towards increased efficiency (Adesiyan et al., 2020). The equipment that results from the deployed technology are driven by electricity.

Most farm settlements are located in remote areas. These remote areas are mostly off-grid zones. Hence, alternative power sources are implemented to drive the farm implements in those areas. The most common energy source in use in these farm areas is the petrol or diesel generator. This system emits gases like carbon monoxide (CO), released from the combustion of the hydrocarbon fuel at the exhaust which are hazardous to human health.This poses a threat to the environment, and contribute to the depletion of the ozone layer (Abatan, Adewale, & Alabi, 2013). Furthermore, noise pollution results from these generators, this cancause a range of health problems(World Health Organization, 2018).

In this work a solar-powered 2.5 kVA motor-driven generator is designed and implemented which does not produce carbon monoxide nor noise.

Methodology

The Biogradable power system is as shown in Fig. 1. It is a Solar Powered Motor-Driven Generator consisting majorly of five sections working together for the generation of clean electrical energy. The rating of the system is 2.5 kVA.

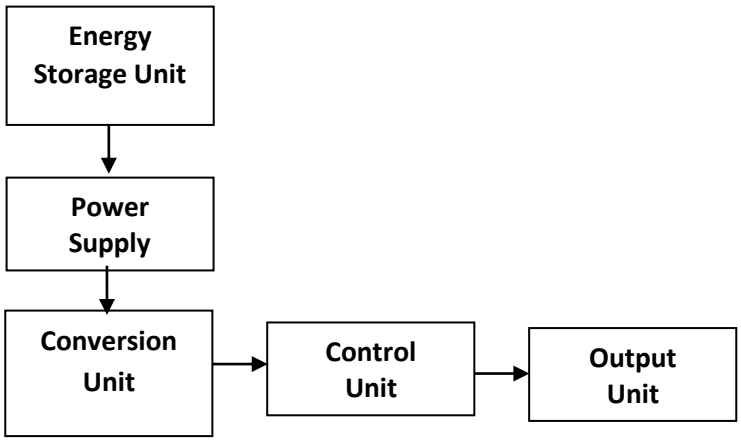

Figure 1: Block diagram

The power supply unit replenishes the battery bank, it is solar powered.Its cumulative power rating is 720 W.The Energy Storage unit consists of the battery.Two pieces of deep cycle lead-acid battery of output voltage 12V/100AH were used. These batteries were connected in series to form a battery bank

of 24V output. The Conversion unit distinguishes the generating set from the popular fuelled generating set. Itconsists of a DC Motor and an AC Alternator.
The Control unit comprises of circuit breakers, cutoff circuit, automatic voltage regulator (AVR), and monitor devices.
The conceptual diagram is shown in Fig. 2.

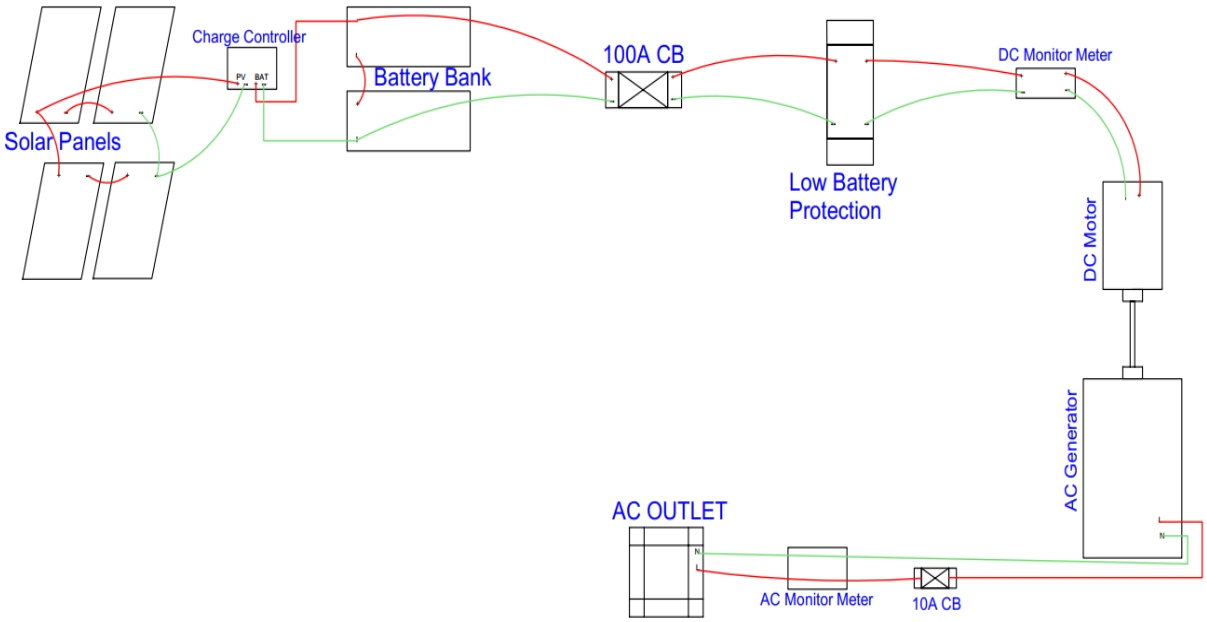

Figure 2: Conceptual diagram

Results and Discussions

A No-Load Test and Load Test were conducted on the Solar Power Motor-Driven Generator for a period of 4 mins (240 s). Output voltage and frequency readings were taken at these instances with the digital multimeter. Noise level was observed using sound level meter, while the smoke examination was done through inspection and expressed in percent of smoke. The system's performance was compared with that of the petrol generator. The no-load and on-load (60 W incandescent bulb) ac voltage performances revealed that the designed system varies slightly from that of the petrol generator, but the output ac voltage varies within the acceptable standard.Frequency performance also reflects a slight variation, but not too distinct. The system's performance even renders a better performance in the early period of the test.

The designed system achieved environmental serenity as its noise level is very low, no smoke at all. This is not in any way hazardous to human health.

Conclusions

The biogradable power system, a 2.5 kVA solar powered motor-driven generating set, was designed and implemented. It produces an output ac voltage adequate for farm machinery. Farm settlements that are located in off-grid zones will be sufficiently supplied with required power using the system designed without environmental pollution.

Keywords

Alternator, dc-motor, food, frequency and voltage