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Design evaluation of a microhybrid generator with attached energy storage

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Introduction

Access to energy is currently an extremely important topic and significant funds are being invested in the development of new technologies that can tackle this situation. While the majority of establishments from developed countries are connected to an electricity grid, with enough supply to satisfy the demand, **17%** of the world population lacks access to electricity. This proportion mainly consists of people from developing regions of Asia and sub-Saharan Africa **[1].**

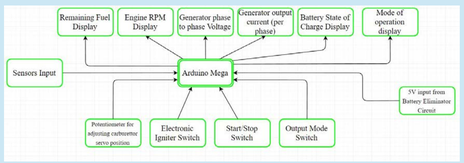
System Overview

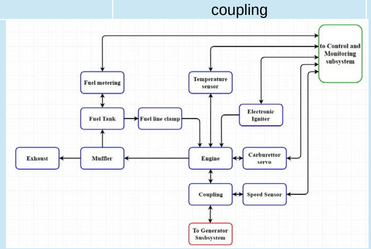
The rig has been developed by a group of 4th year students, but has not been completed or tested. It has been designed to provide a power output of nearly 1kW at 12V, from a compact, portable and safe package. The outcome of the project and the list of components are presented below.

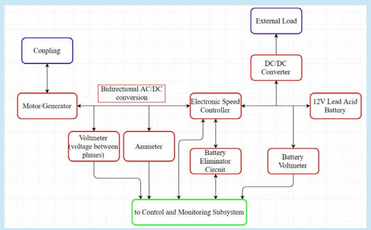
Component	Model	Specifications
Engine	ASP 0.75	1 cylinder, 2 stroke, 12cc glow engine used in model RC planes, 17,000 rpm max
Motor/Generator	OS OMA-3825-750	750 VA brushless motor, 14 poles, 14.8V nominal voltage, 590W power output, 11,000 rpm max.
Battery	RS Pro 12V Lead Acid Battery	12V, 12Ah sealed lead acid battery
Microcontroller	Arduino Mega	-
Power electronics	Overlander XP2 Electronic speed controller; TDK Non-Isolated DC-DC Converter	30 A maximum current, includes Battery Eliminator Circuit 3.3-24V output, 14A, max power 250W
Transmission	-	Direct drive using a machined steel coupling

System configuration

The block diagram of the system is displayed below. It can be divided into three major subsystems: the engine, the generator and the control and measurement subsystems.

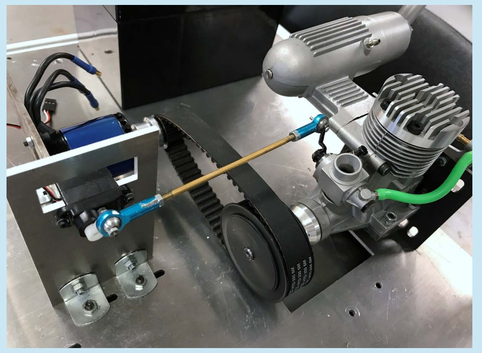


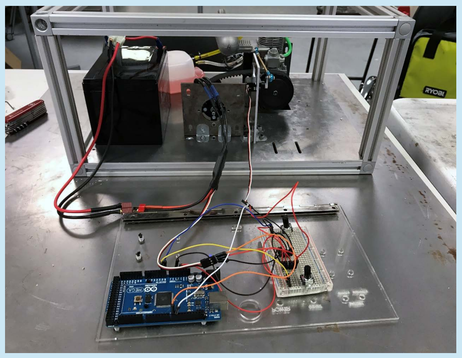




Experimental tests

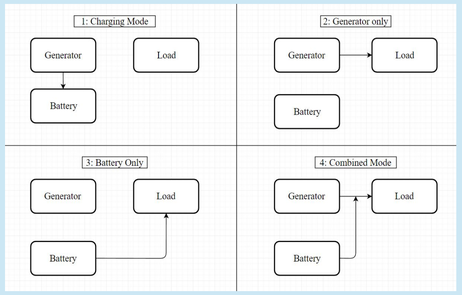
The rig has been completely disassembled and components were individually tested. As the engine was brand new, it needed to be run-in using a propeller, on a separate test bench. Using the available ESC, the motor has been tested at various speeds and the rig has been reassembled, this time with another type of coupling: a toothed belt and two toothed pulleys with transmission ratio of 1:3.





Modes of operation

The system would operate in 4 different modes: Battery charging, when all the power produced is stored for later use; generator only; battery only and combined output.



Future Work

Upcoming work includes replacing the engine with a four stroke, petrol engine, with a peak efficiency reached at under 3000 rpm; testing and characterizing the components; reassembling the system and running several tests with different loads, redesigning the enclosure and implementing a control strategy to automate the genset.

References

[1] Energy Poverty, https://www.iea.org/topics/energypoverty/, [Accessed 05/09/2017]
The first picture of the rig is taken from http://uosdesign.org/designshow2017/group-design-project/micro-hybrid-generator