Photovoltaic Panels LabView™ Controlled – a Platform for Educational Purposes

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1. Introduction

Renewable sources of energy – wind, solar (thermal and photovoltaic), hydro, tidal, geothermal and biomass – are an essential alternative to fossil fuels [1-3]. Using these sources helps not only to reduce greenhouse gas emissions from energy generation and consumption but also to reduce the European Union's (EU) dependence on imports of fossil fuels (in particular oil and gas). In order to reach the ambitious target of a 20% share of energy from renewable sources in the overall energy mix [3-5], the EU plans to focus efforts on the electricity, heating and cooling sectors and on biofuels. In transport, which is almost exclusively dependent on oil, the European Commission hopes to increase the current target of a 5.75% share of biofuels in overall fuel consumption by 2010 to a 10% share by 2020 [6]. Energy and transport are important in climate change since they are the leading sources of greenhouse gas emissions; this is why energy policy is particularly important in the European Union's sustainable development strategy [7].

Several applications with photovoltaic panels (hereafter called PV panels) can be found nowadays. The most common applications are in remote areas without power lines where PV supply energy (sometimes combined with others renewable sources of energy) to rural homes, water pumps, fuel stations, exterior illumination, telecom antennas, road signs also used in boats and motor homes. Recently with the improve of panel's construction technology, and the urgent need finding new energy sources, PV panels have being used to produce electricity in large scale. Portugal is an example with Amareleja project, a 64 MW photovoltaic power plant [4-5].

2. Objectives

The main objective of this work is to give a contribution to the sustainable development. With this objective in mind, it is also an objective of our educational project to study batteries charging with PV panels in respect to voltage, current and temperature measurement and how this variables change according to position of the Sun and PV panels orientation. We decided to use LabView™ to measure voltage, current, temperature in PV and air, and solar radiation and to store it in a database. Another objective is to control two electric motors in order to move the PV panels trough the day. The main purpose of this project is to achieve optimal setup to obtain maximum power from PV panels. That setup includes PV panels' orientation, panels' temperature and solar radiation.

Paper is organized as described below.

First we give a brief approach to Solar Tracking and inherent formulas to control motors. Next we describe how we built this system and what components we used. We also describe the system core presenting LabView™ implementation, how it controls motors and collects information. In the next item we analyze the database created by LabView™ and study how the temperature and weather conditions influences the power output, making previsions about system efficiency and avoidable costs. For last we present conclusions of this project, possible applications and future studies based in the present paper.

3. Main Contribution

In the work presented in this communication, it is performed a complete analysis of several tests with different loads and in different solar conditions. It is presented a comparison between gain of static, 1-axis and 2-axis panels and payback estimation for present configuration. We refer possible applications of this work in new or current projects of our school. In Figure 1 we present a graph of measurements during September 20th, 2007 in ISEC. It was a partly cloudy day and we start collecting data since 10 a.m. to 5.30 p.m. with 2-axis regulations. In this graph we present output voltage and current of PV panels before voltage regulator (V_{in} and I_{in}), voltage and current from voltage regulator to batteries and load (V_{out} and I_{out}) and finally panel and ambient temperatures. Scaling problems doesn't allow represent solar radiation in the present graph.

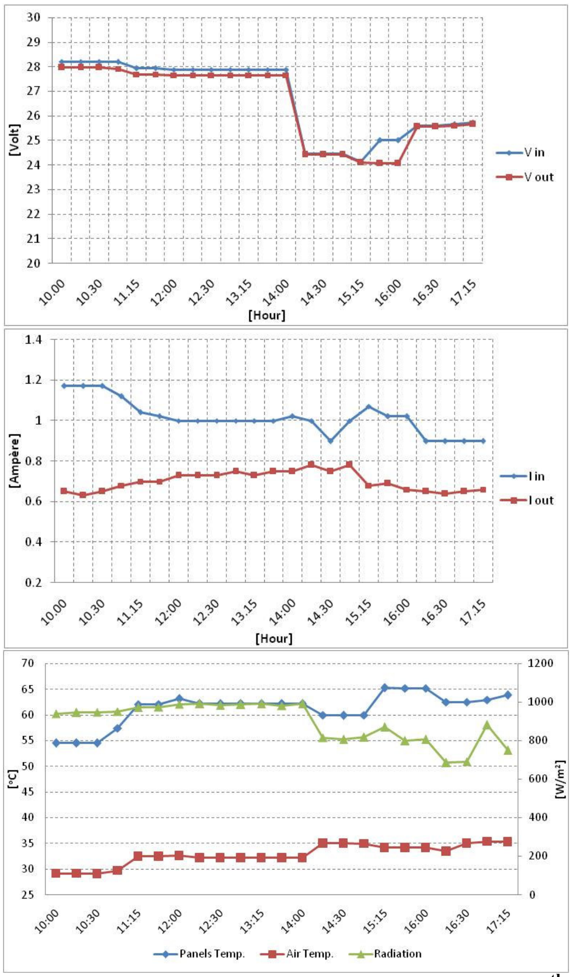

Figure 1 – Measurements during September, 20th

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