Available online at www.sciencedirect.com

ScienceDirect

Procedia Technology 17 (2014) 520 – 527

Procedia Technology

Conference on Electronics, Telecommunications and Computers – CETC 2013

Smart Platform towards Batteries Analysis Based on Internet-of-Things

Vítor Monteiro[a]*, João C. Ferreira[b], João L. Afonso[c]

[a,c]*ALGORITMI Research Centre, University of Minho, 4800-058 Guimarães, Portugal*
[b]*ALGORITMI Research Centre, Instituto Superior de Engenharia de Lisboa, 1900-049 Lisboa, Portugal*

Abstract

This paper presents a new approach of pre-defined profiles, based in different voltage and current values, to control the charging and discharging processes of batteries in order to assess their performance. This new approach was implemented in a prototype that was specially developed for such purpose. This prototype is a smart power electronics platform that allows to perform batteries analysis and to control the charging and discharging processes through a web application using pre-defined profiles. This platform was developed aiming to test different batteries technologies. Considering the relevance of the energy storage area based in batteries, especially for the batteries applied to electric mobility systems, this platform allows to perform controlled tests to the batteries, in order to analyze the batteries performance under different scenarios of operation. Besides the results obtained with the batteries, this work also intends to produce results that can contribute to an involvement in the strengthening of the Internet-of-Things.

Peer-review under responsibility of ISEL – Instituto Superior de Engenharia de Lisboa, Lisbon, PORTUGAL.

Keywords: Batteries Analysis; Electric Mobility; Interne-of-Things.

1. Introduction

Nowadays, smart grids are emerging as a new paradigm towards power grids [1][2]. In this scenario, with the advances in the electric mobility [3], and in the production and integration of renewables, new research challenges are being opened. The main challenge is related with energy storage systems to smooth the intermittent production

* Corresponding author. Tel.: 351 253 510 392
E-mail address: vitor.monteiro@algoritmi.uminho.pt

Peer-review under responsibility of ISEL – Instituto Superior de Engenharia de Lisboa, Lisbon, PORTUGAL.
doi:10.1016/j.protcy.2014.10.189

of renewables, where batteries are the most common solution [4][5]. Taking in account the growing of the energy storage systems area through batteries, it is important the usage of an equipment capable to perform the batteries analysis. This analysis is based in the results achieved from the batteries tests, which are related with different charging and discharging profiles. Although this issue can be ignored for most cases, it is very important to ensure the batteries reliability and performance, and also to prevent failures along their lifetime. Moreover, this equipment can be used to evaluate batteries towards a specific project and to determine the electrical characteristics for their complete characterization under different scenarios of operation. As example, in [6] is presented a reliability and failure analysis of lithium-ion batteries for electronic systems, and in [7] is presented a batteries analysis related with performance. The batteries performance is directly related with the following characteristics:

- Battery Chemistry: Each chemical technology of battery has a specific nominal voltage (as well as maximum and minimum voltage), and charge and discharge curves, even batteries of the same chemistry can have different characteristics according to the manufacturer;
- Temperature: The batteries performance is dramatically influenced by temperatures (when they are used or stored) above or below the limits recommended by the manufacturer;
- Self-Discharge: This characteristic is related with the energy lost when the battery is not in use due to unwanted chemical actions;
- Internal Resistance: The battery internal resistance determines its current carrying capability and the energy lost during operation;
- Charge and Discharge Rates: These characteristics are related with the recommended methods and limits for each battery chemistry, mainly currents, voltages and temperatures.
- Depth-of-Discharge: This characteristic is the battery capacity percentage that has been discharged, expressed as a percentage of maximum battery capacity.

In this sequence of ideas, in this paper is presented a prototype of a smart platform towards batteries analysis, in special batteries applied in electric mobility systems. This platform allows implement controlled tests to the batteries, which consist in different profiles of charge or discharge and that can be applied to different batteries technologies (as example lithium-iron-phosphate, lithium-titanate, or nickel-metal-hydride). Figure 1 shows the architecture of the smart platform, where is illustrated the power flow during the charging (equipment connected to the power grid) or discharging processes (equipment connected to the load). Through these tests it is possible analyze the batteries performance under different scenarios aiming to determine their reliability and performance, as well as estimate the lifetime. The aforementioned platform is based on power electronics in order to analyze the electrical behavior of batteries and is supported on Internet-of-Things (IoT) to control the power electronics hardware. The control and management system of the power electronics platform is based in a microcontroller (DSP from Texas Instruments), which receives a set of commands from an application based on the concept IoT.

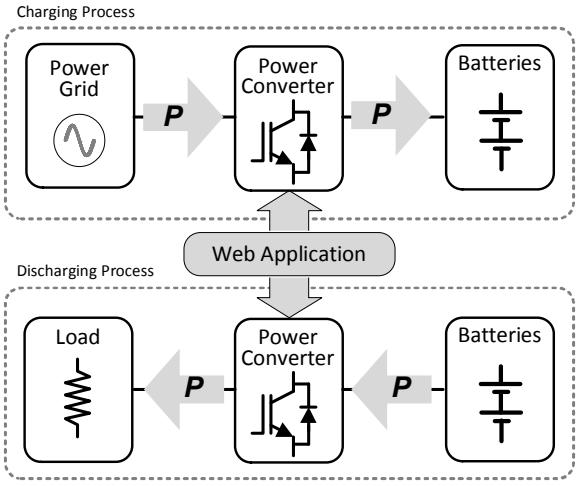

Figure 1. Architecture of the smart platform.