Energy Management System to Handle Emergency Load Managing for EV'S and Portable Inverters on AI

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Abstract - A variety of rechargeable - batteries are now avail- able in the markets for powering different electronic and electrical devices. The lithium-iron phosphate (LiFePO4)/ Lithium Titanate battery is considered to be the best among all battery types and cells because of its superior characteristics to charge very fast and high performance available in market in earlysof 2020. However, considering the charging speed, safety, life cycle, it is very much difficult to manage the huge load when the system is shifting from main power supply source to stand by source. There needs a time to shut down unnecessary loads to the rating of the inverter, otherwise a huge loss of current. Using an artificial intelligent system, it can be managed easily associating with lithium iron phosphate battery. AI technology can decide the priority and energy using from the system by shutting down the un-necessary loads in a proper way without effecting the working system.

Keywords - Super Capacitor, LiFePO4 Battery, Artificial Intelligence, Portable Inverter, Energy Management, Hi-Tech Farming, Emergency Load Management, Electric Vehicle

I. INTRODUCTION

This is the frequent and gradual expansion of the integration of energy storage and power supply applications in the power system, increased the demand for the battery packs rapidly. However, the actual service life of the battery pack is not satisfactory due to the sudden requirement of more ampere. Then the battery status and life cannot be guaranteed, it will be a great threat to the There are many reasons why the battery cannot achieve the expected service life, including manufacturing process, production quality and perfections, the use of materials. But the most important reason is the improper battery management program, resulting in overload while sudden change in the power supply from grid to battery and whole system will shut down after a warning from the system. More than that this whole charge of battery neglects the difference of batteries' internal resistance, capacity. Under this charge module, batteries run with cycles of charge and discharge and it is easy to make battery's port voltage variance. So some batteries occur over-charge and over-discharge. The phenomenon cause drop of battery performance, and then drop of storage battery performance sharply. The battery which performance is bad make DC power supply exist hidden trouble. Meanwhile the module charge can't fulfill request of great output power and quick charge. So the State-of-Health (SOH) estimation of LiFEPO4 is essential for the energy management system (EMS). A feed-forward artificial neural network has been used to estimate SOC.

II. EMS DESIGN PRINCIPLES

A. Energy Storage system

The lithium iron phosphate battery which is also known to be a type of best rechargeable battery, using LiFePO4 as the cathode material, and a graphitic carbon electrode with a metallic backing as the anode. The advantage of this type of battery is fast charging, light weight, Low internal resistance and more life cycle. So the sudden discharge does not affect the life cycle. Based on two problems about charge module technologies of Battery Time-sharing Charging Management System (BTMS) and Battery Synchronous Charging Management System (BSMS) respectively. Two kinds of technology also object single battery to monitor and charge, the difference is schedule control. Firstly, charge of unit module charges whole battery and monitoring of unit module is able to detect every single battery rapidly. If the monitoring of unit module detects some battery achieving tiptop charge voltage of rating, then charge of unit module stop charging and system switch to next step and go on.

B. Management System

Electronic system which is able to manage a rechargeable battery pack, such as by protecting the battery from operating outside its safe operating area monitoring its state, calculating secondary data, reporting that data, controlling its environment, authenticating it and balancing it. A battery pack built together with a battery management system with an external communication system. A smart battery pack must be charged by a smart battery charger, but before charging battery balancing circuit has to use for setting up the battery storage system for better performance.

Fig. 1 80Ah 24V Battery

C. Role of AI in Management System

Battery management system will control the temperature, charging and discharging speed, load management, power management etc. with the help of AI system. [2]AI system is trained to shut down the load understanding the emergency situation where the load is using. This AI system helps to charge the battery with maximum efficiency by reducing the temperature and adjusting charging time. But it will charge all the batteries equally, which helps to get necessary power for priority areas. [3] The effective users of the load is capable to give the priority of their loads if they are engaged in a work, depending the nature of their work.

III. HARDWAREANDSOFTWAREDESIGN

A. Hardware Design

The hardware design consists of battery management system with a balancing circuit for the battery which is connected in parallel with it to maintain the voltage. Battery management system is associated with a program build in it for self-training to make decisions on load and power management. An energy management system which is inter connected with AI control unit with battery supply, grid supply, Electrical/ Electronic Devices. Even the system demands more power than required also battery is able to provide the back up. When the main grid supply lose the trained AI system will shut down the loads according to the usage. For example, if it is a hospital what will happen if the power of operation theatre go down, it will effect the treatment. So AI system will manage the load adjustment which is integrated into centralized unit commitment with optimal power flow coupled energy management systems for integrated systemfor optimal generation and peak load dispatch. The smart loads are integrated with a neural network load estimator as a function of the ambient temperature, usage time duration day/night and the peak demand imposed by the AI system. To develop the Neural Network-based smart load estimator, realistic data from an actual energy hub management system is used for supervised training and self-learning. [1]Basedon these, energy management system (EMS) framework based on a model visible and predictive control approach is proposed using IOT (Internet Of Things), which yields optimal dispatch decisions of dispatchable production, energy storage system, and peak demand for controllable emergency and unwanted loads, considering power flow and usage simultaneously. Control of module takes charge to gather key information of each module. The key information such as voltage value and current value of real-time charge is displayed to screen. And the general control of module can receive the input of information from user where the loads are using and priority can set on the device. System is formed by a main supply of module and symmetrical charge of module on every battery. And two different modules are also formed by monitoring of unit module and charge of unit module. The main supply of module and symmetrical charge of module can detect voltage, internal resistance and temperature of battery real-time, as well as evaluate capacity of battery and will inform whether the attached capacity of battery is sufficient or not.

B. Software Design

The Software embedded with the battery management system will perform according to the power in the battery and the load which is currently using for emergency purpose. The system will work only according to the change in situation because the system is trained to do. Python is used for the programming for the fast performance. It has a capability to check and maintain the charging time, delivering time, load managing, balanced charging etc.

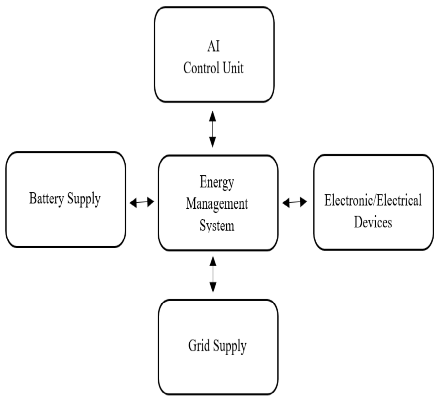

Fig. 2 Block diagram of Hardware Design

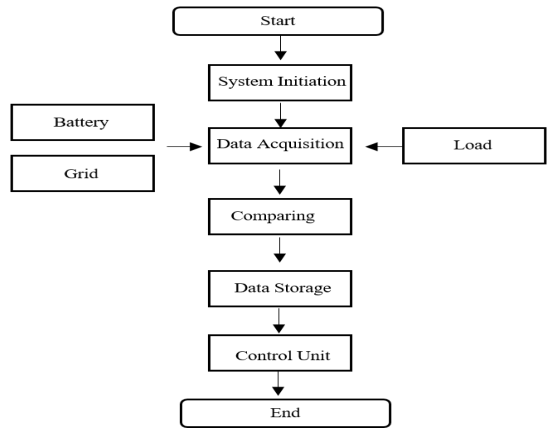

Fig. 3 Algorithm of the system working

IV. EXPERIMENTALRESULT

The design of the EMS on the battery status such as single cell voltage, charge and discharge current, working environment temperature and SOC value can be accurately monitored in real time by means of a system connected with Internet of Things. [4][5]The voltage, current, temperature and SOC in the experiment are managed by the AI system and notifies the big variations. In addition, the equalization module effectively suppresses the inconsistency of the single cell voltage, which is of great significance to extend the service life of the battery packs to get maximum life to reduce the investment. From the graph it is clear that the graph is increasing step by step while charging and LiFePO4 is holding maximum voltage until the end and make a sudden drop only at the end. Since it is the sudden drop and maintain the voltage till last moment, stability of voltage will be there. It will help the machineries to work properly in rated value. More than that the charging and discharging will not effect the life cycle of battery, since it is working in optimum condition and it is also working with good performance in different temperature also. The clear picture of charging and discharging is available from the graph mentioned above. Graph mentioned in fig.5 shows the comparison of discharge rate in both lead acid with the LiFePO4battery.

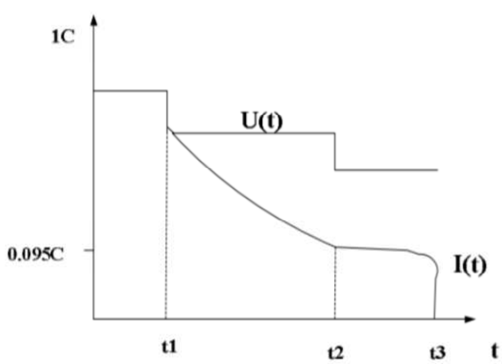

Fig. 4 Charge curve of current and voltage

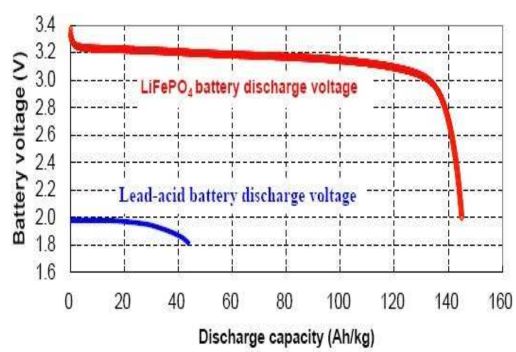

Fig. 5 Discharge curve

V. CONCLUSIONANDEXPECTATIONS

In this paper, there are two management units, the battery management unit and the central management unit compose the two- different level control structure to form EMS device. The result will be the improved life cycle of battery which is able to perform its own, the innovative hardware module has been added to ensure the operation of the EMS. The integrated power supply helps to the smooth performing of equipments in the sudden failure of main supply. Energy Consumption is also reduced since the system is vigilant during the supply from mains also. In electric vehicles and inverters, a demand of huge power is required LiFePO4 is able to hold the voltage in a constant position to maintain the performance. The system adjustment with the integrated load and storage system with the AI trained energy management system will help to save energy, Cost, Space and perform highly in the emergency situations. The algorithm of the system is capable of self learning and takes necessary decisions.

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