CHAPTER - 9

SCOPE FOR THE FUTURE WORK

In the present investigation, an Artificial Neural Network (ANN) based smart charger for lead-acid batteries has been designed and developed. It is a PC based control system incorporated with an elegant hardware and software package to render most efficient charging to lead-acid batteries. A user friendly and interactive virtual instrumentation software package of the smart charger facilitates online monitoring and control of charging parameters.

As an extension of the present investigation, Very Large Scale Integrated circuit (VLSI) based System on Chip (SoC) design can be taken up to miniaturize the PC based smart charger design. As an initial phase of the SoC design and developmental work, a PIC (Peripheral Interface Controller) microcontroller or FPGA (Field Programmable Gate Array) based smart charger will be designed. Its firmware will incorporate the BPN simulator and its hardware package will include on-chip 10 bit ADC, I/O ports, and high power MOSFET drivers connected to the on-board sleek SMPS charging supply. It can render smart charging to 6V, 2 Ah any type of lead-acid batteries at different charging current rates from 1 C A to 10 C A. With suitable high power drivers incorporated in its hardware package, it can provide smart charging to lead-acid battery or any other secondary battery of higher voltage and higher capacity.
It can be designed and developed as a single IC based smart charger which can communicate with smart batteries which are the products of future technology, through System Management Bus (SM Bus) of the smart batteries and render most efficient energy management besides providing most effective charging.

Life cycle tests incorporated with smart charging in its charging mode of operation, can be carried out on lead-acid batteries for estimating the increased number of life cycles of the lead-acid battery influenced by the smart charging method. By means of appropriate material characterization using scanning electron microscopy (SEM) and x-ray diffraction (XRD) techniques, it can also be further extended to investigate and analyze the influence of smart charging on the active materials of the lead-acid battery.

Back propagation network (BPN) based on-line intelligent control algorithm can be custom designed so as to provide smart charging to any battery of any chemistry. And also it can be so designed with any other additional control input and output parameters of lead-acid battery charging process which will directly quantify its charge acceptance rate, such as SOC and state of health (SOH) that may evolve in the near future as a result of continuous on-going research in the field of design aspects of batteries and their charging algorithms.

The smart charger can be designed and developed with high resolution and high speed hardware and software package so as to enable more precise
monitoring and control of charging parameters at a time interval shorter than 20 S. Multi-channel monitoring and control system of smart charger can be designed with 16 bit ADC/DAC channels for sensing and measuring even very small changes in the charging parameters in the order of a few micro volts. Suitable design and development of high speed hardware and software package can result in execution of smart charging in accordance with the charge acceptance rate of the lead-acid battery at a very small time interval as short as 1 S.

The design of smart charger can further be modified and developed together with relevant modifications in the lead-acid battery design pertaining to its internal resistance and its heat capacity for suitable incorporation as one of the functional modules in on board battery energy management [BEM] system for electric vehicle [EV], hybrid electric vehicle [HEV] applications and in smart lead-acid battery system design which is one of the present R&D activities.