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SYNTHESIZABLE INTEGRATED CIRCUIT AND SYSTEM DESIGN FOR SOLAR CHARGERS

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ABSTRACT

In this project, an automatic design tool for a solar energy harvesting IC and system is developed with visual basic software, and the synthesis tool employed in this approach can be used to shorten the design time to market. In addition, a smart meter system is developed to measure the solar energy harvesting system's information with an online system. Users can thus get the proposed system's information at any time and from anywhere. Finally, good agreement has been found between the analytic and experimental results.

I. INTRODUCTION

DEVELOPING sustainable energy sources and improving power management technologies have become more and more important. The most common sources of sustainable en- ergy are solar and wind power. The output power of solar panels is affected by environmental factors, such as irradiance and temperature, and solar energy harvesting systems generally use maximum power point tracking (MPPT) and charge algorithms to minimize problems associated with these. MPPT algorithms are used to operate solar panels at the maximum power point (MPP) and include approaches such as perturb and observe, incremental conductance, fractional open-circuit voltage, fuzzy control, neural networks, and detecting the real peaks for partial shading effects.' The charge can be delivered to the battery through different charging schemes that depend on the battery chemistry. Too quickly, safely, and efficiently charge a Li-Ion battery, charger circuits typically start by sourcing a regulated current into the battery and end by forcing whatever decreasing current is necessary to charge the battery to a regulated full-charge voltage, all of which constitute the well-known constant current to constant voltage (CC-CV) technique. The suitable transition time of the two modes affects not only the charging time, but also the life-cycle time of the battery. Moreover, there are many advantages associated with digital designs, such as programmability, lower sensitivity to process, and parameter variation. However, the resolutions of such systems are limited and the cost is still high. In contrast to digital control technologies, a lot of analog control technologies have also been proposed, such as pulse width modulation (PWM), pulse-frequency modulation , and dithering skip modulation . In analog designs, the key concerns are the high-speed response and high efficiency.

II. BATERRY CELL

A battery cell is an electrochemical cell that converts a source battery into an electrical current. It generates electricity inside a cell through reactions between a battery and an oxidant, triggered in the presence of an electrolyte. The reactants flow into the cell, and the reaction products flow out of it, while the electrolyte remains within it. Battery cells can operate continuously as long as the necessary reactant and oxidant flows are maintained.

Battery cells are different from conventional electrochemical cell batteries in that they consume reactant from an external source, which must be replenished a thermodynamically open system. By contrast, batteries store electrical energy chemically and hence represent a thermodynamically closed system. Many combinations of batteries and oxidants are possible. A hydrogen battery cell uses hydrogen as its battery and oxygen (usually from air) as its oxidant. Other batteries include hydrocarbons and alcohols. Other oxidants include chlorine and chlorine dioxide.

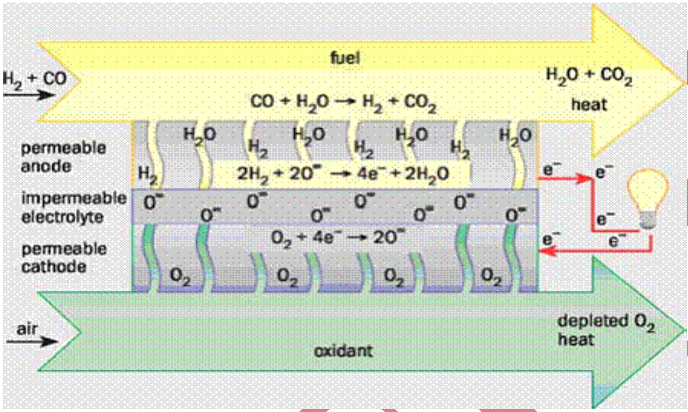

Fig 1. Operating Principle of a Solid Oxide Battery Cell

An SOFC essentially consists of two porous electrodes separated by a dense, oxide ion conducting electrolyte. The operating principle of such a cell is illustrated in Figure. Oxygen supplied at the cathode (air electrode) reacts with incoming electrons from the external circuit to form oxide ions, which migrate to the anode (battery electrode) through the oxide ion conducting electrolyte. At the anode, oxide ions combine with hydrogen (and/or carbon monoxide) in the battery to form water (and/or carbon dioxide), liberating electrons. Electrons (electricity) flow from the anode through the external circuit to the cathode. Battery was charged by sub-motor. This operation was priority to over other actions. Figure 2 shows the modified configuration of hybrid system proposed in this study. In the modified system, CVT was utilized to keep constant revolution numbers of the sub-motor when the sub-motor contributed to assist the system.

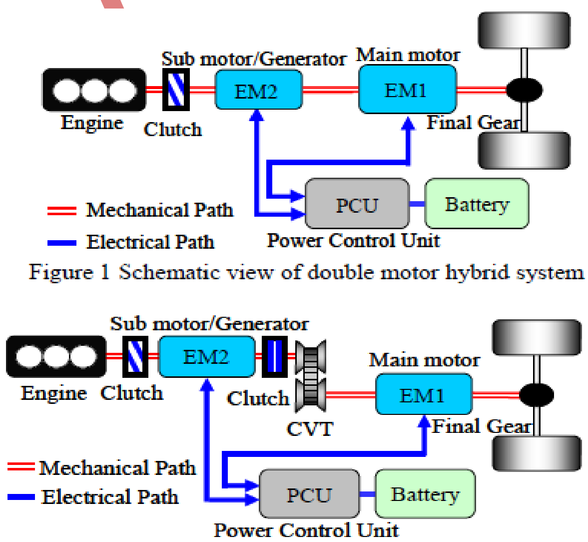

Fig 2 Schematic View of Double Motor Hybrid System with CVT

2.1 PV/Genset Hybrid System Description

The PV/genset hybrid utilizes two diverse energy sources to power a site's loads. The PV array is employed to generate DC energy that is consumed by any existing DC loads, with the balance (if any) being used to charge the system's DC energy storage battery. The PV array is automatically on line and feeding power into the system whenever solar insolation is available and continues to produce system power during daylight hours until its rate of production exceeds what all existing DC loads and the storage battery can absorb. Should this occur, the array is inhibited by the system controller from feeding any further energy into the loads or battery. A genset is employed to generate AC energy that is consumed by any existing AC loads, with the balance (if any) being used by the battery charger to generate DC energy that is used in the identical fashion to that described for the PV array above. At times when the genset is not running, all site AC power is derived from the system's power conditioner or inverter, which automatically converts system DC energy into AC energy whenever AC loads are being operated. The genset is operated cyclically in direct response to the need for maintaining a suitable state of charge level in the system's battery storage bank.

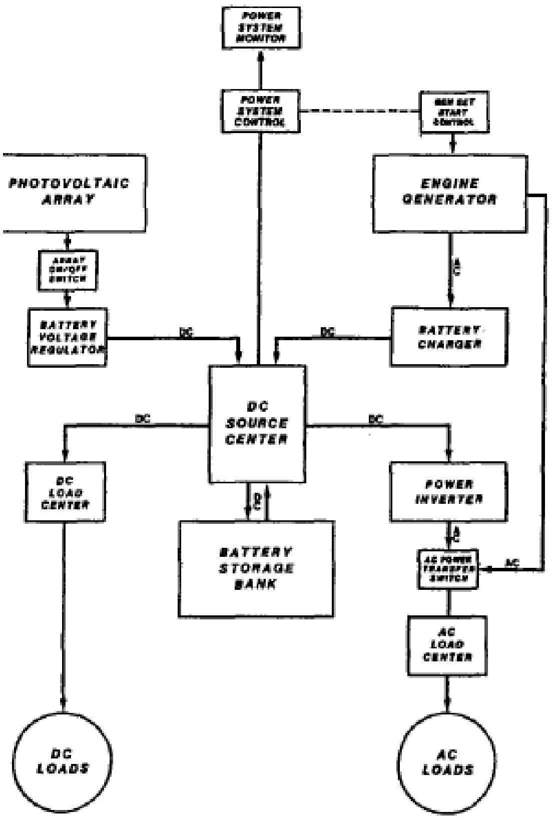

Figure 3 Block diagram of a hybrid PV-Genset system.

III. ARCHITECTURAL INTEGRATION

The last two decades have brought significant changes to the design profession. In the wake of traumatic escalations in energy prices, shortages, embargoes and war along with heightened concerns over pollution, environmental degradation and resource depletion, awareness of the environmental impact of our work as design professionals has dramatically increased. In the process, the shortcomings of yesterday's buildings have also become increasingly clear: inefficient electrical and climate conditioning systems squander great amounts of energy. Combustion of fossil batterys on-site and at power plants add greenhouse gases, acid rain and other pollutants to the environment. Inside, many building materials, furnishings and finishes give off toxic by-products contributing to indoor air pollution. Poorly designed lighting and ventilation systems can induce headaches and fatigue. This ability to island generation and loads together has the potential to provide a higher local reliability than that provided by the power system as a whole. Smaller units, having power ratings in thousands of watts, can provide even higher reliability and battery efficiency. These units can create microgrid services at customer sites such as office buildings, industrial parks and homes. Since the smaller units are modular, site management could decide to have more units (N+) than required by the electrical/heat load, providing local, online backup if one or more of the operating units failed. Also much easier to place small generators near the heat loads thereby allowing more effective use of waste heat. Basic Microgrid architecture is shown in figure 4. This consists of a group of radial feeders, which could be part of a distribution system or a building's electrical system. There is a single point of connection to the utility called point of common coupling. Some feeders, (Feeders A-C) have sensitive loads, which require local generation.

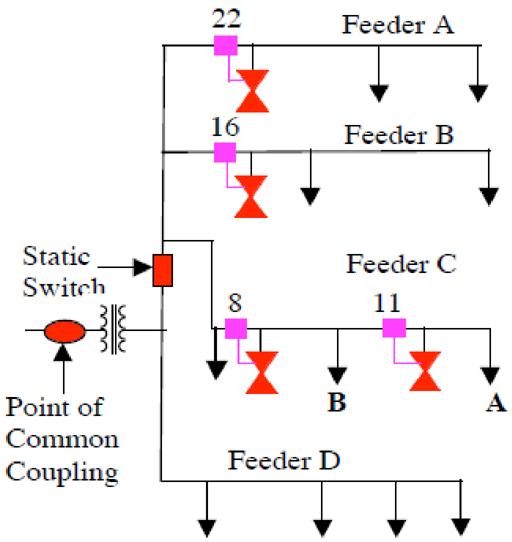

Figure 2 Microgrid

IV. SIMULATION DIAGRAM & RESULT

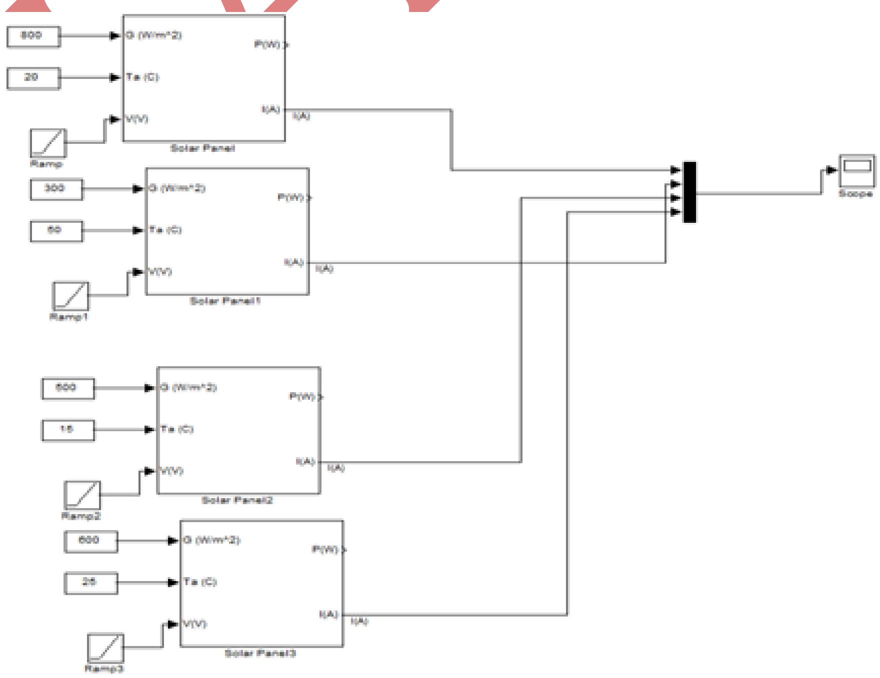

Fig 5 Solar Chargers SYSTEM

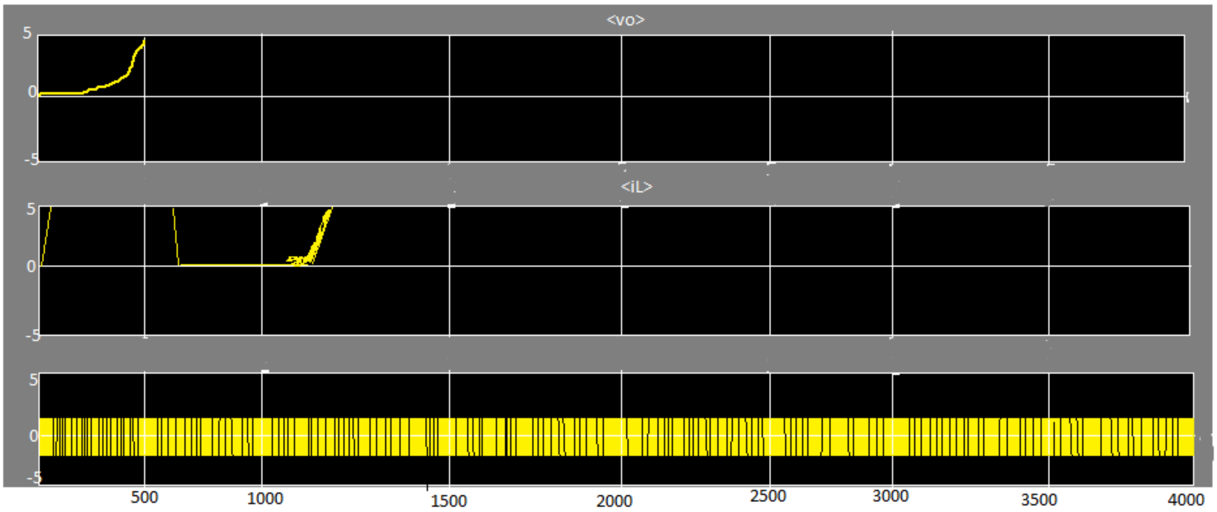

Fig 6 Result Output Graph

V. CONCLUSION

In this project, a synthesis tool is developed to reduce the design time to market for solar chargers. The IC and system performance, including MPPT accuracy, converter efficiency, and compensator design, is well analyzed. A smart metering technique is proposed to measure the IC and system performance, and thus, this project presents a total solution for solar charger designs.

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