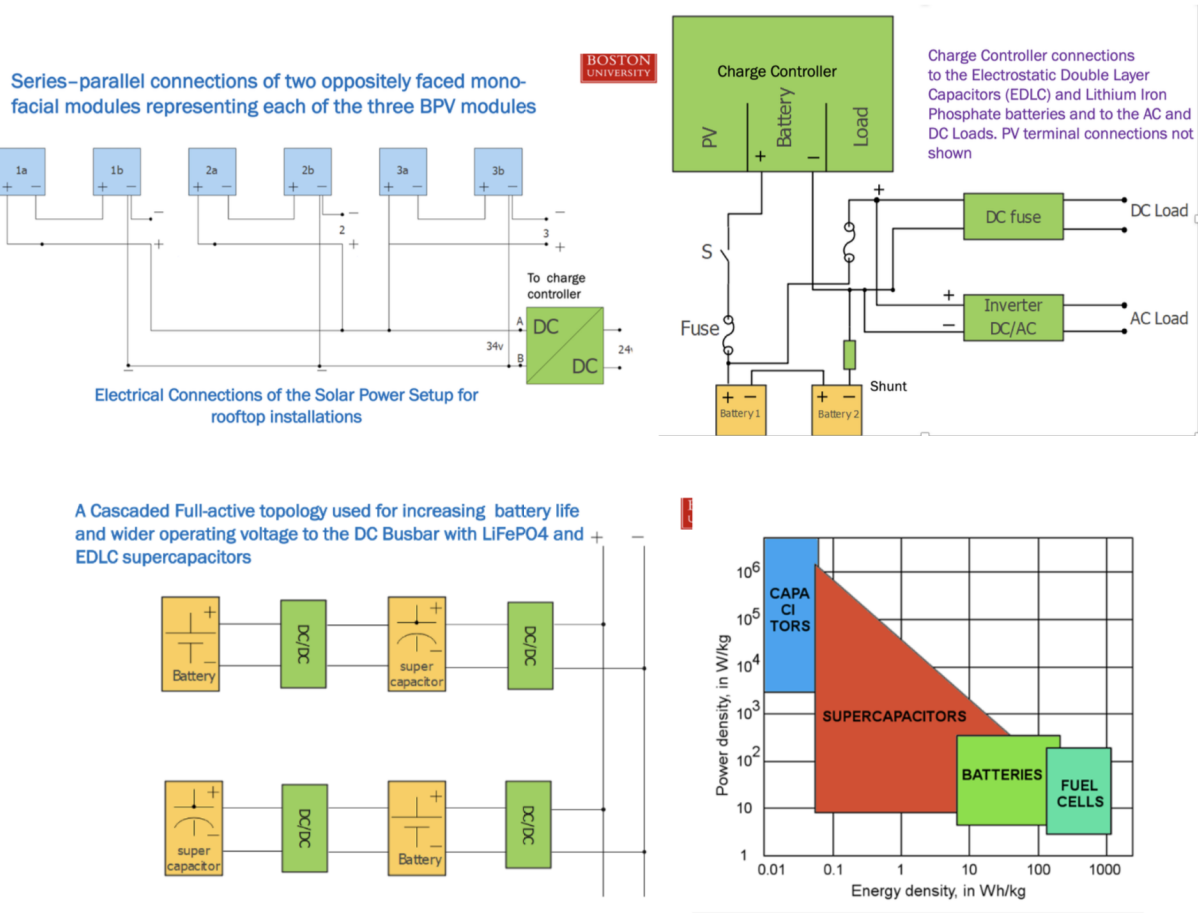


Senior Design Project 2023-2024

Title: Development of a monitoring and control system for operating a stand-alone solar energy plant, with a hybrid energy storage system using lithium-iron-phosphate batteries and super-capacitors

Stand-alone solar energy plants with energy storage capacity are used in many applications in the US and abroad where manual operation is difficult or not desirable. While these plants do not require manual operation, energy storage through lithium-ion batteries becomes essential for meeting energy needs. However, this introduces reliability concerns as well as safety risks of fire or explosion. A monitoring system is needed to check the operation of the system (power output) and the status of the batteries with respect to their charge level, the rate of charging, and charge dissipation. Recording logged operational data and automating trend analysis for anomaly discovery is also critical. A hybridized energy storage process is used in combination with electric double layer super-capacitors and lithium iron phosphate batteries in cascaded operation with a DC bus bar as shown in Fig.1.



Last year a senior design project team developed a solar energy system to which we have added a cascaded hybrid energy storage device. We need a remote monitoring and control system for its operation as a stand-alone solar plant to ensure reliability and safety. Determining the plant power output as a function of the solar irradiation incident on the solar panels and maintaining a record of the charging status and the rate of charging and dissipation are of critical importance.

The solar energy system is currently installed in the lab (PHO 109) will be used for a lab-instruction component of the solar energy system classes for students enrolled in the class to have hands-on experience in the operation of stand-alone PV plants.

The senior design team working on the project this year will be provided with the solar panels, charge controller, batteries, super-capacitors (EDLC and Li-ion batteries). The team will design and assemble the system with electrical integration including the monitoring and control system for remote operation (within 5000 ft). The team will demonstrate the operation and deliver the control and monitoring devices used in connection with the solar plant with detailed instructions.

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