

Small Scale Stand Alone Hybrid Solar PV and Wind Energy Generation System for EE 452 Lab

Team sddec20-16 : Daniel Mendez, Benjamin Holt, Samah Shabbo, Conner Makoben, Mohamed Adam

Advisor/Client: Venkataramana Ajarapu - Professor of Electrical Engineering

Introduction

Problem Statement

- Fossil fuels proven to have environmental impact
- U.S Carbon Dioxide emissions = 1,763 million metric tons
- Temperature rise of 2.5 to 10 degrees Fahrenheit
- Need for new renewable generation systems.

Solution

- Teach and interest undergraduate EE students in renewable generation systems.
- Design and develop a standalone hybrid renewable energy generation system using wind and solar PV energy
- Hardware and software implementation in EE 452 Lab and Coover Courtyard
- Develop lab experiments for EE 452 students.

Requirements

Functional

- Model solar PV panels and wind simulations
- Generation energy from solar cell and wind turbine.
- Power conversion from AC to DC and from DC to AC.
- Maintain power quality of system for various loads.
- Storage of the excess power.

Non Functional

- Generate clean energy using maximum power point tracking algorithm, inverters, battery bank, and controllers.
- Regeneration system adheres to safety standards.
- Metering of systems to prevent overvoltage/overcurrent.
- Testing and implementation.
- Design lab experiments for students

Operating Environment

- Coover Hall/ EE 452 Lab

Implementation

Standalone Solar PV System

- PV array
- Maximum power point tracking (MPPT)
- Buck Converter

Standalone Wind System

- Wind turbine
- Permanent magnet synchronous generator (PMSG)
- 3-phase rectifier
- Low pass filter
- Buck converter

Hybrid System

- Solar generation system
- Wind generation system
- AC Inverter
- Battery bank
- DC & AC loads
- Battery Charge Controller

Testing Environment

Physical

EE 452 lab
Testing existing solar hardware system

Virtual

- Matlab Simulink simulations
- Simulating multiple generation systems

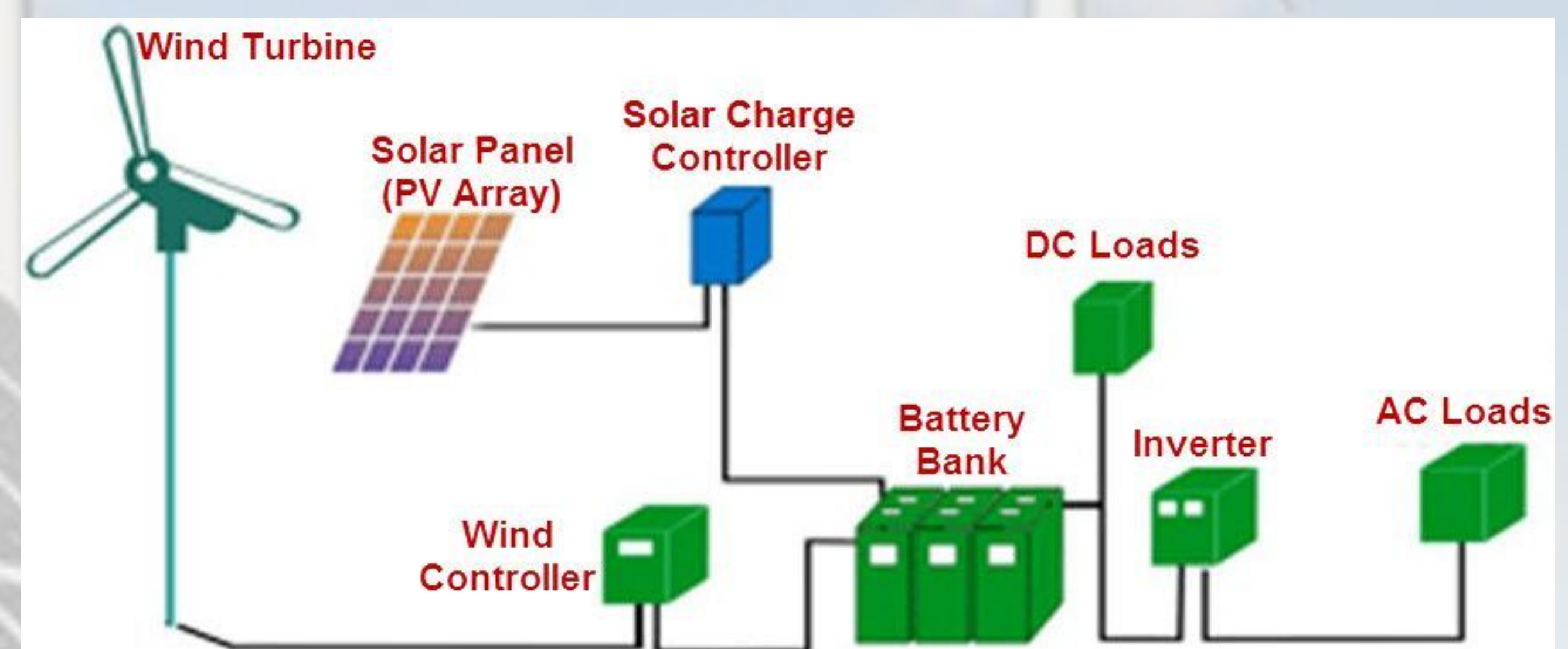
Testing Strategy

- Mathematically verify all signals at each step.
- Develop and complete educational lab experiments and case studies to verify each generation model is functioning properly with regards to system

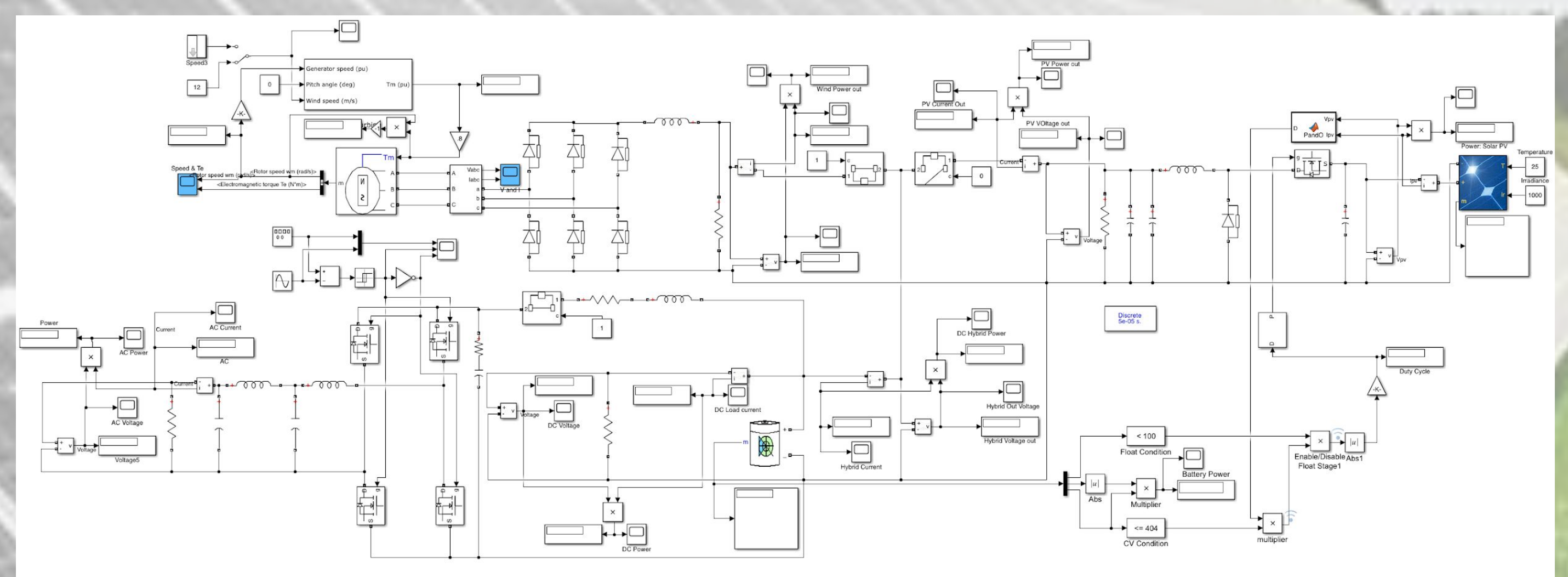
Standards

- IEEE Guide for terrestrial Photovoltaic Power Systems Safety
- IEEE Guide for Selecting, Charging, Testing, and Evaluating Batteries in PV Systems

Conceptual Sketch



Block Diagram



Future Plans

- Execute hardware implementation of hybrid system
- Hardware and Software model optimization
- Centralize documentation
- Develop standard operating procedure
- Develop hazard analysis
- Design hardware lab manual
- QA/QC checkout
- Application research