Senior Design Project Proposal
“Triple J’S”

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Introduction

The general goals of this project are:

- To understand the functioning and simulate a smart microgrid system.
- To understand the functioning and use of Wifi communication with a microcontroller.
- To understand the principles of power taken into consideration to charge a battery bank and simulate a charge controller.

Problem Description

- In many places, large grids have been unreliable or non-existent which calls for the use of microgrids.
- These are smaller scale grids that offer more modularity, reliability, savings (in terms of costs) and control to the user.
- Given the fact that microgrids are generally not powered by a utility company, in order to ensure access to energy, the system is usually accompanied by a battery bank.
- To ensure the longevity of the said battery banks, the individual batteries must not be overly charged or overly discharged as specified by its manufacturer.

Proposed Solution

- The proposed solution for this project is to emulate a smart system by reproducing a charge controller to which a load, a battery bank and some charging sources are connected.
- The charge controller prevents the battery from being overly charged or discharged by frequently checking its voltage.
- The charging sources will include a solar module, a small wind turbine and a small generator.
- We will have different sensors to check insolation and wind intensity to determine which is the best charging source at a given time.

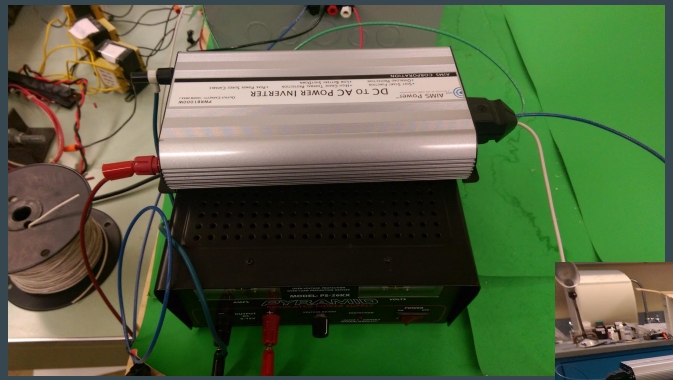
Demonstrated Features

- 3-stage battery charging
- Field Adjustable
- DC load controller mode
- LED status indicator
- Wireless communication

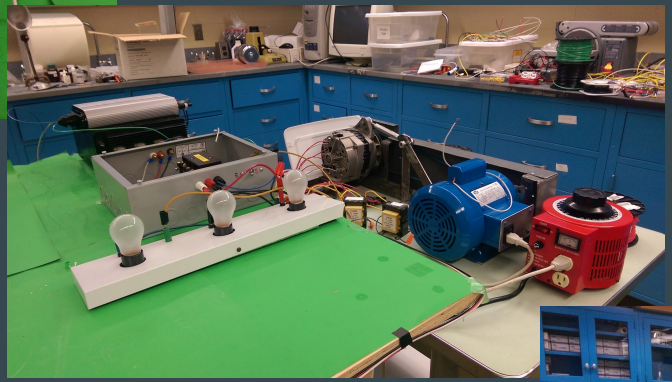
Available Technologies

- Multimeter ($0)
- IRF3205 mosfet -switch to vary duty cycle ($6.88 for 5)
- SaintSmart 4-Channel Relay Module (for connections and disconnections of souces) ($9)
- Galileo2.p microcontroller ($45)
- Silicon Labs Wireless transmitter and receiver. ($4.56/pair)
- Anemometer equipped with a transmitter (to measure wind speed). La Crosse Technology TX-23U ($44.95)
- 6 V UPG UB645 Sealed Lead Acid Battery ($12)
- Solar radiation sensor for VantagePro2 (wireless) ($150) (to measure sun radiation)
- Small DC power supply accompanied by a DC-AC inverter to convert the current from DC to AC. (We can use a DC power supply and an inverter from Dr. Ken Sauer's Village Project- see **Figure 1** below). ($0)
- Variac Variable Transformer. (to simulate AC wind power). PHC Enterprise- SC-3M ($65)
- Generator (from Dr. Sauer's Village Project- see **Figure 2** below). ($0)
- Small system to represent the loads (to this end, we can use the campus electrical maquette in Dr. Sauer's Village Project- see **Figure 3** below). ($0)

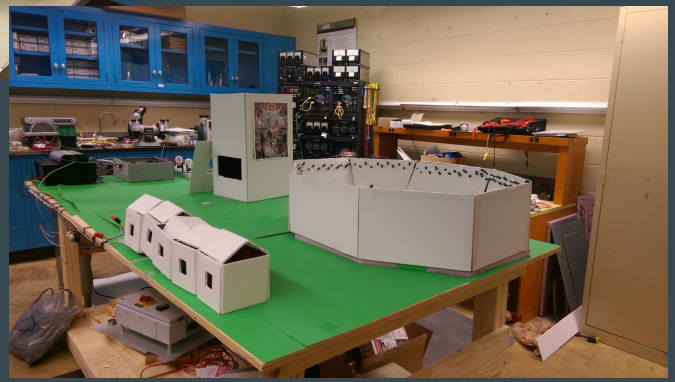
TOTAL = $456



DC Power Supply & Inverter. Simulating Solar Power



Generator at our disposition

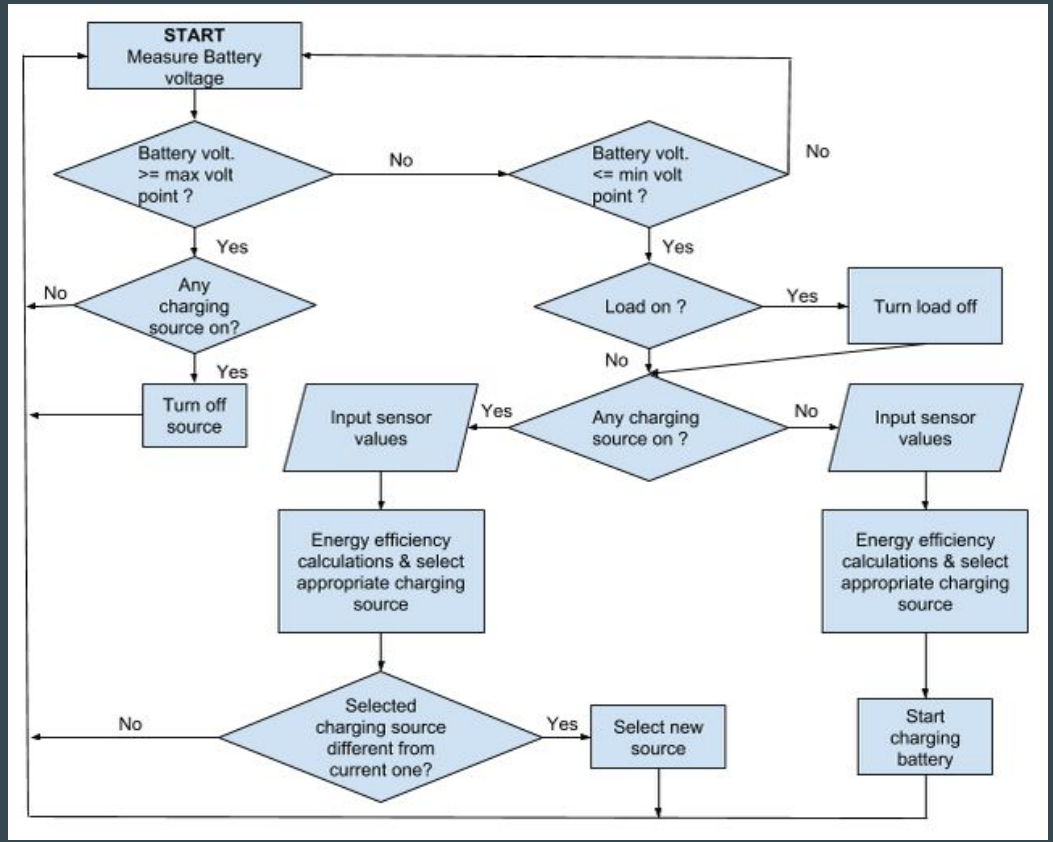


Electrical Maquette of Campus- LOAD

Engineering Content

- Control of charging current
- Limiting the voltage and ending the charge cycle at the appropriate time
- Design of thermal shutdown to avoid potential catastrophic events
- Lots and lots of work with spec sheet and controller schematic
- Wireless communication between sensors and charge controller
    - Possibly also between voltmeter and computer to perform power consumption calculations at the load.

Microcontroller Program High Level Diagram



Conclusions

- Establish a smart microgrid system in Fitzpatrick.
- Use the sensors remotely.
- Have sensor readings sent to receiver (connected to microcontroller) through wifi.

Possible additional modules:

- Measure battery temperature & shut down at given level.
- Measure voltage and current at different nodes to display on a computer screen.
- Perform power calculations at load.
- PWM charge performance