PROJECT HELIOS

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Group # 10

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Sponsor:

- University of Central Florida, Department of Energy
- Mr. David Norvell (Energy Manager)

  (Director of the department of Sustainability & Energy Management for UCF)

The Need of Solar Energy

It is all about going "Green" lately. From coffee cups to water bottles, a little caption could be found on the products on how they produced them with little or no harm to Earth. Even after all the efforts being made in going green, and today's technology, we don't see much difference in household energy supply; it is still the same way as it has been since past a half century. For example, a giant energy company is providing electricity in a specific area. The public does not have options, they are stuck paying high energy bill every month.

The Idea behind the PVC Farm

As fresh Engineers, we are looking to provide solutions to the energy supply in a green manner. And a great way of doing that is using natural resources, mainly using PVC also known as Photovoltaic Cell or Solar Cell. The idea is to create a solar farm within the property of the UCF campus so we can cut down the energy cost. A solar farm is just like any other farm, except it doesn't grow fruits and vegetables and does not need irrigation. However, it does need sunlight to produce desired results.

Multiple arrays of solar panels will be mounted on a plain field. And each panel will consist of four to five solar cells depending upon the size and specification of the cell. All the panels will move along the sunlight to produce maximum results. Each array would actuate separately independent of other arrays in the farm, which will make it easier to maintain in the future. It will also help the solar panels to move accurately because of less lag since each array can be seen as connected in series.

Each array will have a photo sensor which will govern the actuator according to sunlight. The photo sensor will guide the panels to absorb maximum sunlight to produce maximum results.

Each panel would be attached to a voltmeter, determining the output voltage from each panel. Along with the voltmeter, a wi-fi system will be attached to each panel which will send the voltage reading to a computer. That will allow us to monitor each panel output voltage individually. For example, if panel X is producing only 100 volts and it is supposed to produce 150 volts, by computer monitoring, we will know it is panel X that is malfunctioning and needs maintenance. We can approach the problem directly for maintenance or troubleshooting without going through other 1000 panels.

A bus cable will connect all the panels to a Grid Connect System. The solar panels when exposed to sunlight generate DC current, while there are some appliances available that will run directly from DC current, most appliances require AC current. In order to switch the current

type, we will need a Power Inverter. The inverter will sit in a main grid connect system which will provide friendly AC current to power our computers, lights etc.

We will not be storing any energy or charge batteries for later use as our peak power consumption matches with the peak solar energy. We will be using all the energy produced by the solar farm daily. Keep in mind, this project is not intended for UCF to be completely independent and self sufficient of energy. The idea behind this project is to cut UCF's electricity costs. We still need to have energy providers since solar farm will only be producing a fraction of energy during rainy days.

Project Helios

From the looks of it, the PVC farm will require some experienced professionals and lots of cash to implement. Not to mention, eight months is not enough time either. As students, we possess none of those.

So we have decided to scale it down to a much smaller level and call it "Project Helios". Since we are going to be using a lot of sun, the name Helios suits it just right for the senior design project. We will probably use only one or two panels. The functionality of the system will stay the same. However, there will be a small difference between the PVC farm and Project Helios. In our project, we will be using a battery instead of Grid Connect System. Since at the smaller level, we will not get sufficient output voltage to connect the panels to a grid, besides the fact that only a certified technician can play with grid connections by Florida state law.

The battery will be charged using the energy produced by solar panels. Between the bus wire and battery, there will be a voltage regulator controlling the voltage flow. We could use the charged battery to power up a laptop or a television.

The object here is not to power up a laptop or a television, it is just to provide load to complete the circuit. The main idea will still be implemented which is to monitor the voltage produced by the solar panels wirelessly. A wi-fi system will be attached to our panels sending data to our laptops.

In simple definition, our project will be a micro prototype of the real idea. According to the UCF Department of Sustainability and Energy Management, if our prototype produces desired results and if we meet the budget and functionality at a smaller scale, the University of Central Florida will begin the construction of the solar farm next year. UCF has already allocated a specific area for the potential PVC Farm. That's going to help all of us set an example to other colleges and universities around the nation. Also, it will make us well known after graduation and it will help us in finding a good career after we graduate.

Specifications and Requirements

Solar Panels:

Panels selected for the project are mono-crystalline solar panels which are the most efficient in absorbing sunlight and converting it into electricity.

The number of panels required for the implementation of the project will be determined after a meeting with Dr. Samuel Richie and Mr. David Norvell. For the case of our study model we are going to assume a four panels Array.

1. **Solar Panel Mounting Hardware:**

Two options are going to be considered for the project:

a. **Active solar tracker**
Solar panel trackers can produce more power in a day than a fixed solar panel array as they "track" the sun's path, but they are the most expensive.

b. **Ground mounts**
Ground mounts are solar panel mounts that are installed on the ground. They have supporting, adjustable legs which allows optimizing their vertical orientation for solar exposure, and will allow adjusting their orientation for seasonal patterns of the sun.

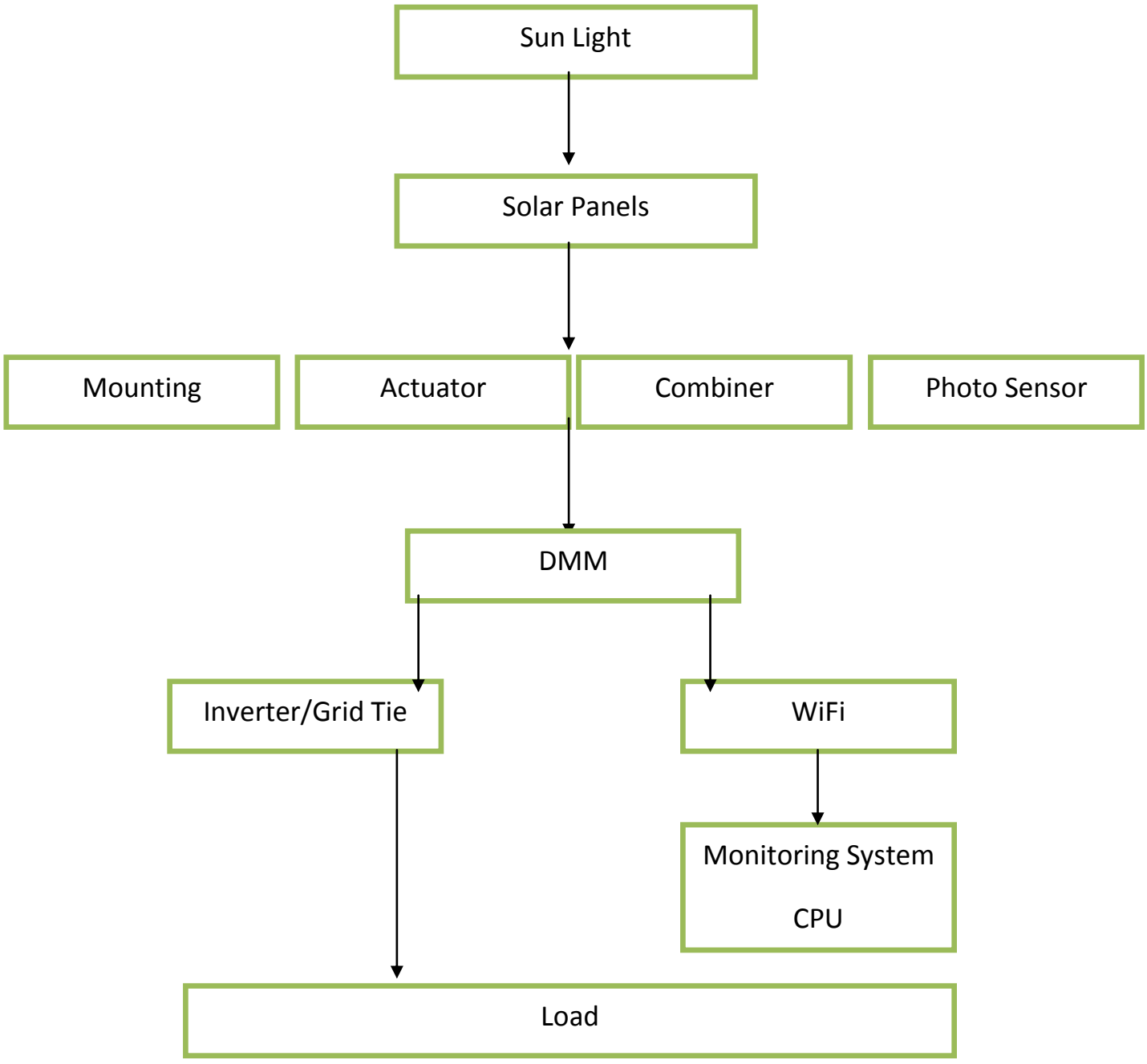
2. **Combiner Box:**
A solar combiner box combines several solar panels into one DC output to connect which in turn is going to be fed in the Inverter.

3. **Grid – Tie Inverter:**
It is an inverter that feeds into the grid directly since we are not going to utilize batteries for the storage of excess energy.
The goal of our design is to use 42 volts DC as the input into the inverter, as a higher voltage system carries less current, which makes the system's wiring cheaper. The output is an AC signal with 120 v at 60 Hz.
The selection of this device will entirely depend on the loads that will utilize the energy from our setup to choose a device capable of withstanding the power required for starting the loads.

4. **Monitoring Device:**
This is the part where we are going to utilize our engineering education to design and implement a device capable of simultaneously monitoring current, voltage and power of four solar panels. The device will acquire a reading on the users request; the data read will be wirelessly communicated to a PC for the user to make decisions on the performance of the system. This device will indicate whether all of the panels are working at maximum performance or not.

PV Farm Block Diagram

This is the block diagram for the initial design of the PV Farm Project. Of course this is a rough idea of what will being going into the design of our project, it will be updated and modified as the design requirements change throughout this process.



Financing

- We have a projected sponsorship by Mr. David Norvell (Energy Manager) UCF Department of Sustainability and Energy Management of $10,000.
- An application for the Progress Energy grant of $1500 for Renewable and Sustainable Energy is in pending.

Budget

5. **Solar Panels:** $300 for Monocrystaline panel, 85W, Voc = 48volts, Icc = 2.65 amps.
6. **Solar Panel Mounting Hardware:**
   a. **Ground mount:** 30$
   b. **Tracking mount:** 120$
7. **Combiner Box:** researched fabricating a combiner box at the cost of 60$ per six modules.
   Commercially available for 150$.
8. **Grid – Tie Inverter:**
   Cost will vary greatly on the power handled.

9. **Monitoring Device:**
   A rough estimate to build the device is 250$.

Semester Milestones

The milestone that our team has set for the first semester is to have a 120 page rough draft report detailing the research we have conducted along with our design and test procedure outlined. To accomplish this goal our team will break down the overall milestone into smaller goals. First we will set a goal to have our research on our solar array and monitoring system done mid way in the semester. From here my team will work hard to have a prototype design drawn up with individual parts selected for the project. Finally our team will have a typed report detailing our project with all of the above included, also we would like to have all the parts needed ordered or singled out and ready to be ordered.

For the second semester our group's main milestone will be to have a working prototype meeting the specs listed in part 3 of this document, along with a revision of the 120 page report detailing everything that went into the project. We will also break this semester up into a number of smaller goals in order to accomplish the overall task on time. The first of the smaller goals will to have all parts ordered within the first week of the semester at the latest. Secondly we will set a goal to have a prototype of the solar array built by the middle of the semester. This will allow us to complete another secondary goal of testing and debugging our system. The final goal of the second semester is to have our 120 page report revised and updated along with a working prototype. Our group feels very strongly that if these smaller goals are reached by their deadlines we will be able to complete the milestones set forth for both semesters on time.