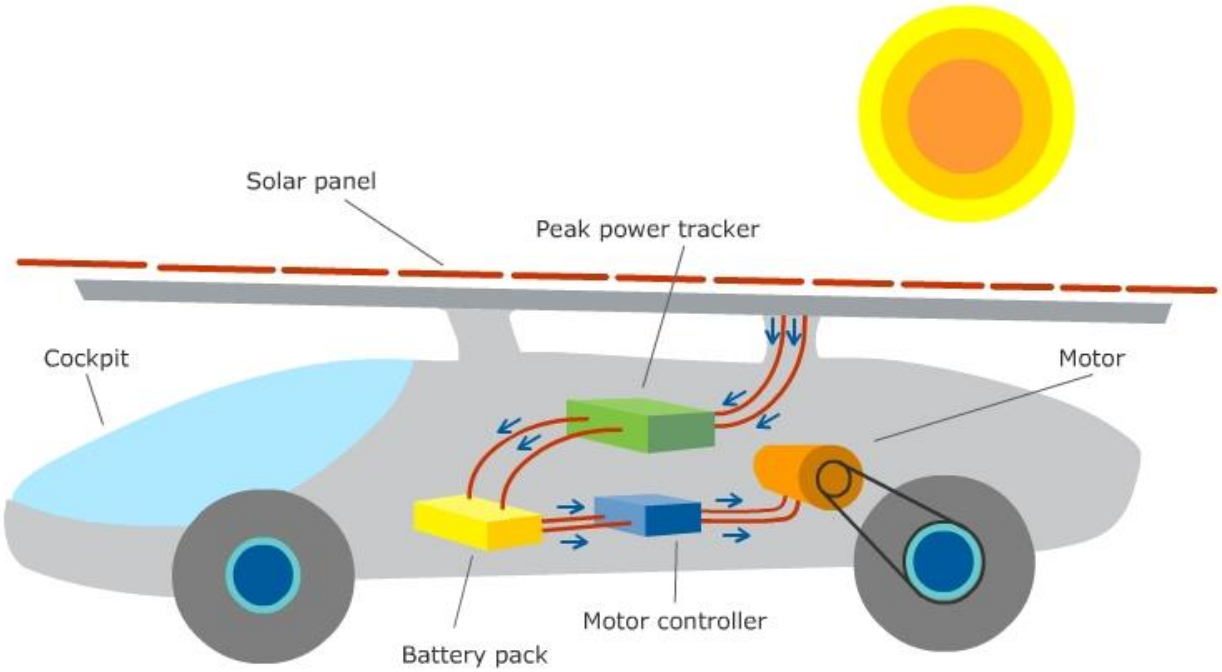

Florida Solar Beach Buggy Challenge
Senior Design I

Sponsored By:
Duke Energy

Group 1
Robinson Charles - Electrical Engineering
Jared Cozart - Photonic Science and Engineering
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University of Central Florida

Project Narrative

In today's modern age, the number of autonomous vehicles being researched on, introduces, and even being sold is growing bigger and bigger. With the number one factor to vehicle accidents being the human driver, it is indeed wise for civilization to move forward to a more effective pilot that cannot be distracted and can analyze a plethora of information instantaneously and at real time.

In another note, with fossil fuels being a nonrenewable source of energy as well as it being a serious danger to our environment, the research for safer, cleaner, better, and more efficient forms of fuel energy continues. One of the topmost candidates is something that is always available and itself provides an overabundance of energy naturally is our very own star, the sun.

The goal of this project is to design and build a buggy that is capable of transporting a person along a beach. The buggy will run on solar power and operate autonomously; meaning that it will need to be able to navigate around any obstacles it encounters, and stay on the beach. These requirements necessitate that the buggy is large enough to carry a person, comes equipped with sensors that allow it to monitor its nearby surroundings, and has solar cells with which to power it. Additionally, it needs to be able to move easily along sand.

In order to achieve these goals, it will therefore be necessary to create seperate systems that can then be connected with each other and accommodated onto a single platform. An optical system will need to be created that can interact with the environment around the buggy in order to gather information, which can then be transferred to a computational system for analysis, such as image identification. From this analysis, the computational system will need to be able to interface with the mechanics of the vehicle in order to avoid a collision with people and objects on the beach. A system of solar cells for power generation will also need to be incorporated onto the buggy, and all of these systems also need to be incorporated in such a way that their combined power consumption does not exceed the limits of the power provided by our solar cells. Considerations must also be made with regards to the structural integrity of the buggy, such that it is able to safely carry the weight restrictions we are made to design for.

Requirement Specifications

The following project constraints in Table 1 has been provided to us by Duke Energy. The goal of the project is to design a system that meets or exceeds the requirements below while travelling along a beach.

1.0	The system shall have the ability to run completely on solar
1.1	The system shall be able to run up to 3 mph
1.2	The system should be capable of transporting a passenger up to 120 lbs
1.3	The system shall conform to applicable local ordinances
1.4	The system shall have the ability to travel up to 10 miles
1.5	The system shall have the ability to detect and avoid stationary and moving objects
1.6	The system shall have the ability to operate autonomously
1.7	The system shall not harm the environment and the beachgoers
1.8	The system shall cost no more than $ 2000

Table 1: Requirements

Block Diagram

Figure 1 illustrates the working block diagram we have for the Buggy system.

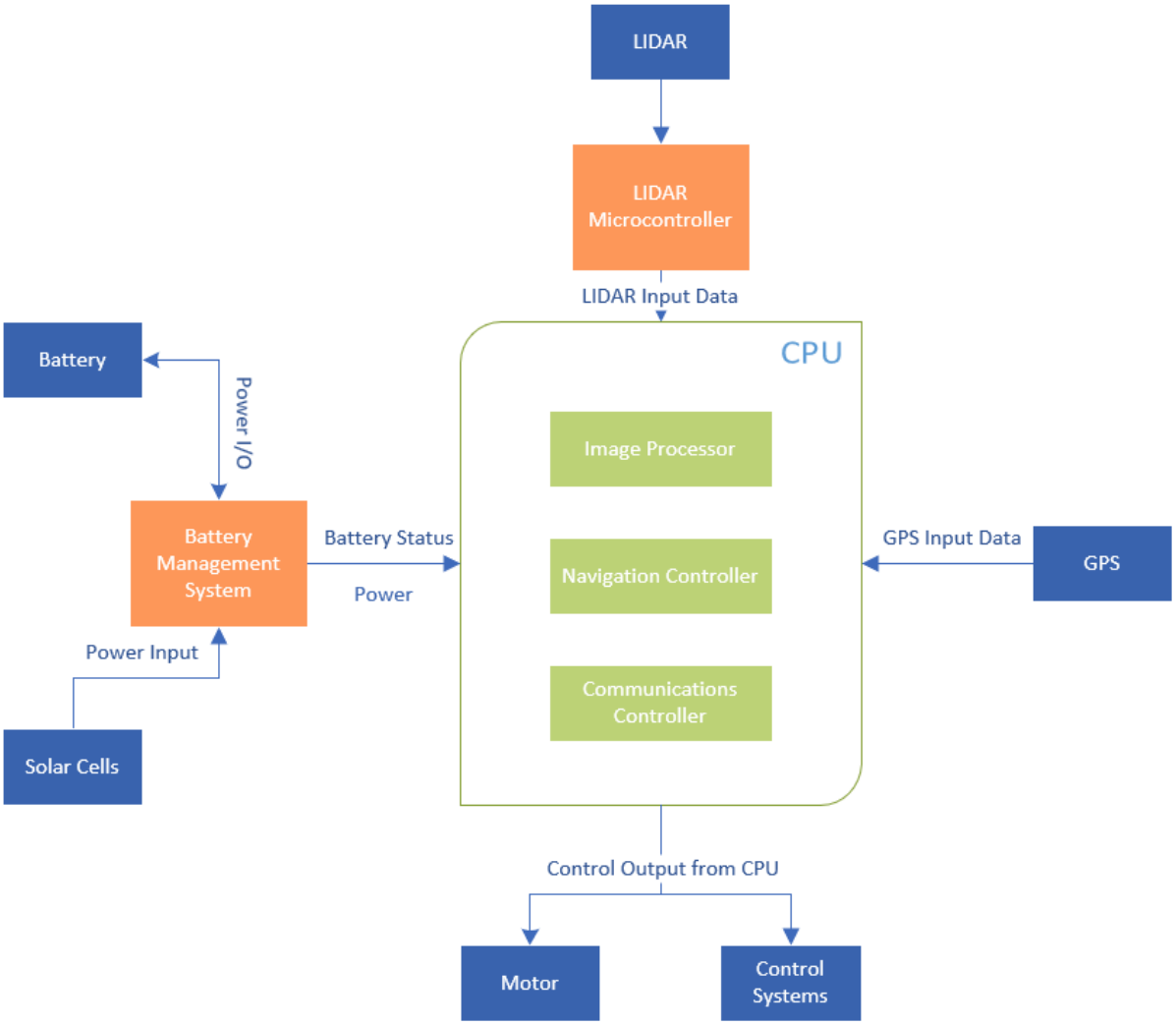


Figure 1: Block diagram

Block Status: All currently under research.

Block administrators:

Robinson Charles

Antenna

Battery Management System
LIDAR Microcontroller
Solar Cells

Jared Cozart
LIDAR
LIDAR Microcontroller

Tony Jimogaon
Communication Systems
Image Processor
LIDAR Microcontroller
Navigation Controller

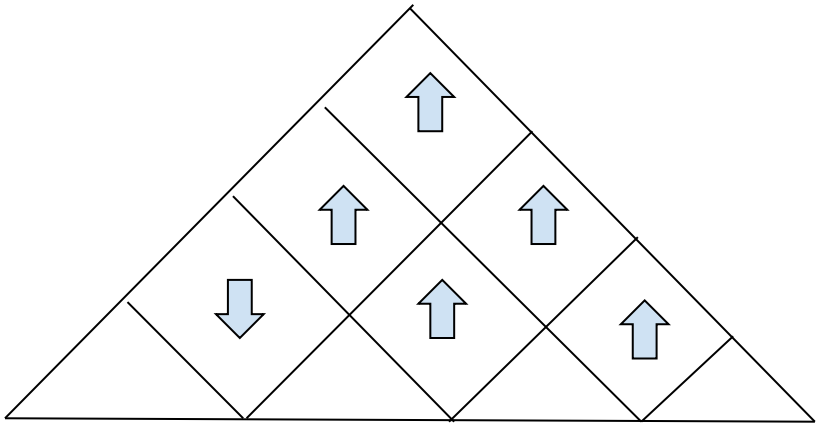
Jose Rosales
LIDAR
LIDAR Microcontroller

Diagram Legend

Antenna - Transmits and receive data.
Battery - Stores and expends excess energy from solar cells.
Battery Management System - Manages input and output to or from the battery and provides power to the whole system.
Communications Controller - Manages communications I/O to or from the antenna.
Control Systems - Control surfaces that direct the motion of travel of the buggy.
CPU - Contains hardware and software responsible for managing the buggy.
GPS - Receives positioning data from the Global Positioning System (GPS)
Image Processor - Analyzes received input data from LIDAR.
LIDAR - Light Detection And Ranging (sometimes Light Imaging, Detection, And Ranging). This is the eye of the buggy.
LIDAR Microcontroller - Receives LIDAR input and transmits it to the CPU.
Motor - Provides forward and backward motion for the buggy.
Navigation Controller - Responsible in controlling the motor and control systems.

House of Quality

Based on the requirements on Table 1, Table 2 lists the House of Quality as part of our Quality Functional Deployment.



		Structural Integrity	Speed	Power Consumption	Cost
		+	+	–	–
Avoidance	+		⇊	⇈	⇈
Cost	-	⇈	⇈	↑	⇈
Safety	+	↑	⇊	↑	⇈
Weight	+	⇈	⇊	⇈	↑
Targets for Engineering Requirements		Can carry a minimum of 120 lb	Maximum of 3 MPH	Self sufficient for 8 hours minimum	Maximum of $2,000

Table 2: House of quality

Project Budget and Financing

ITEM	QUANTITY	PRICE ESTIMATE
Motors	2	$300
Display	1	$100
Custom pcb	1	$200
Power source	1	$200
Microcontrollers	3-4	$100
Wireless ultrasonic sensors	2	$100
Solar panels	2-3	$400
Charge controller	1	$100
Buggy	1	$400
LIDAR	1	$300

Table 3: cost estimations

With a budget of $2000, Table 3 shows a rough estimate, based on preliminary research, on what the parts and the overall cost of our project will be.

Project Milestones

Table 4 lists major project milestones and their approximate times of completion.

Senior Design 1		
Number	Milestone	Planned Completion Week
1	Brainstorming	1-2
2	Project selection	2
3.	Divide and conquer	3
4.	Research and documentation	4-11
5.	Table of contents	12
6.	writing	13
7.	Design	14
8.	Final Senior Design 1 Paper	15
Senior Design 2		
Number	Milestone	Planned Completion Week
9.	Order PCB and parts	1-2
10.	Build prototype	3-4
11.	Testing and revisions	5-9
12.	Final Testing	10-11
13.	Final Report	11-12
14.	Presentation	12

Table 4: Project schedule and milestones

Background Information

Solar Cells:

Solar cells (aka photovoltaic cells) are devices that convert photons into electricity via the photoelectric effect. When a light shines on a solar panel, it excites the outer electrons in a semiconductor material, which results in the excited electrons escaping their orbitals and becoming free electrons. The doping of the semiconductor materials causes these free electrons to flow and produce a current. Figure 2 visualizes a cutout of a typical solar cell.

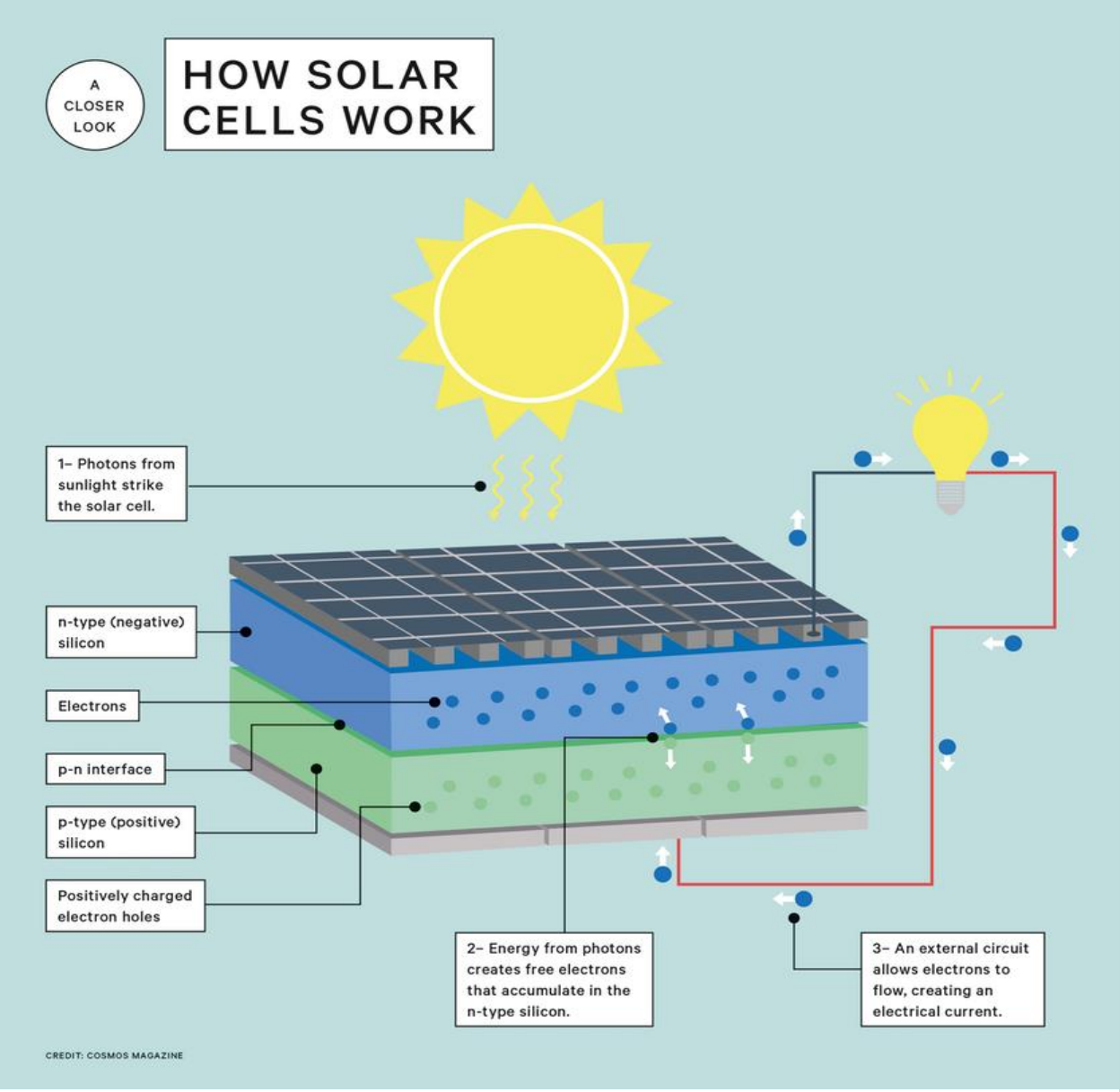


Figure 2: Diagram of a solar cell

LIDAR:

LIDAR stands for “light detection and ranging” and is often used for machine vision. It works by sending out laser pulses and recording the time it takes for the pulse to return. Sending out many quick pulses while moving the laser around allows the LIDAR to create a real-time 3D map of its environment. Figure 3 visualizes the parts of a typical LIDAR system.

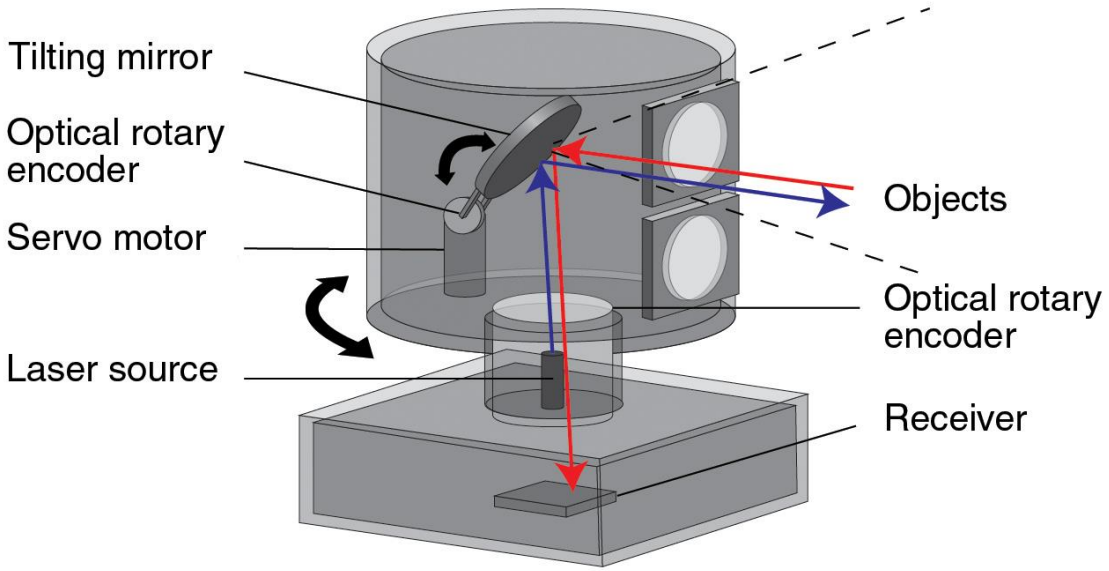


Figure 3: Diagram of a typical LIDAR system