Northeastern University
College of Engineering

GE 1110
Professor J. Love

MODEL SOLAR CAR
DESIGN PROJECT SPECIFICATIONS

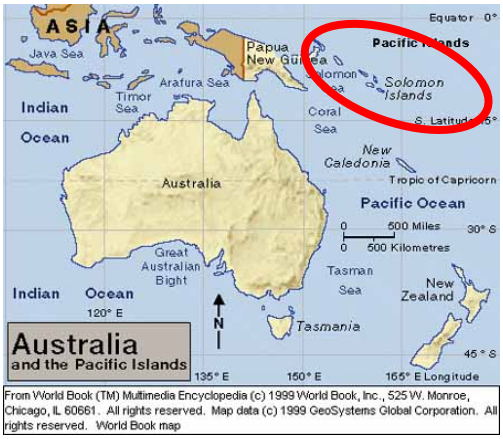

Figure 1. Location of Solomon Islands.

Figure 2. Children in a remote village.

PROBLEM STATEMENT

The problem is that islanders on the Solomon Islands in remote villages walk 2-3 hours to collect kerosene for their lamps and cooking stoves, time they could be using to grow crops or to do other productive work. Farming is their way of life. They grow cassava (a starchy root, similar to a potato), dalo (herb), bananas and other foods. The climate is hot and tropical. Cash is a rare, precious resource. Bank accounts are unusual, borrowing is atypical and saving money is unheard of.

OBJECTIVE

In a team of 2-3 students, design and build a solar-powered model car that can transport at least one small payload (one Tupperware container of water instead of kerosene) for at least a distance of thirty (30) feet on a flat smooth surface. This project is considered the prototype analogy of an actual design that would be implemented in the Solomon Islands to help the islanders transport kerosene from a town to their remote villages.

Figure 3. Students racing their solar cars.

TEST DAY & COMPETITION DAY DATES

- June 6, June 18, June 19 & June 20 in-class, outdoors if sunny.

SPECIFICATIONS

- You must plan, draw (using sketches, AutoCAD and/or Solidworks), design, and construct this vehicle in a team of 2-3 students. You may choose your own partner(s) or ask to be assigned to a group. Your team must work together on this project, not divide the work.
- Your vehicle will be demonstrated in the classroom on both Test and Competition Days. You will have multiple opportunities to test your design in class and on your own time outside of class. You will have an opportunity to revise, correct and improve your design, if needed.

- Your design must be original even though there are many kits available in stores and online. Use these for ideas and inspiration, but make your design original, creative and professional quality as much as possible.
- Your design must weigh less than 3 pounds (less than 1.36 kg) without the Tupperware container.
- Your design must be less than 12 inches (30.48 cm) wide by 24 inches (60.96 cm) long by 12 inches (30.48 cm) high.
- Your design can use components from a purchased toy (or components you already have) but your final design must be at least 75% of your own original design and handiwork.
- Your design must be powered only by sunlight (except when run by 3-AA batteries exclusively on rainy or cloudy days). No energy storage devices (flywheel, battery, etc.) may be used with the solar panel.
- The 4.5 volt photovoltaic (PV) solar panel must be able to be removed from the vehicle and easily disconnected from the motor (do not solder the solar panel to the motor leads). The vehicle must be structurally sound without the solar panel.
- Only one (1) 4.5 volt (PV) solar panel and one (1) MC-05/07 motor allowed per car. One of each will be provided to each team.
- No active steering mechanisms will be allowed (no remote control guidance, for example).
- The vehicle must be designed with a compartment to carry a payload of a Tupperware container full of water (provided) for all competitions. The additional payload for the power "category of excellence" will be multiple Tupperware containers of water.
- The race lane is 28 inches wide and 30 feet long. The track is a hard flat surface such as an asphalt tennis court or running track. The track may be oriented in any direction (north-south, east-west, etc.). You may need to incorporate a way to angle the solar panel in any direction, at any angle, depending on the position of the sun at the time of testing and competition.

DESIGN CONSTRAINTS

- Safety of all participants and observers is most important. Your design shall not have any sharp edges, broken parts or be made from hazardous materials.
- Your design shall not contain any styrofoam "peanuts" or other non-biodegradable components.
- University property must not be damaged during testing, demonstrations and racing.
- Your team can spend up to $20 maximum on the project (expenses to be equally shared by all team members, $10/student or less).
- Except for components and tools that will be provided by Professor Love (battery pack, solar panel, motor, gears, pulleys, wires, alligator clips, soldering iron), you and your team will be responsible for purchasing all components which you may decide to incorporate into your design (chasis, wheels, axle bearings, special gear boxes). However, if more than one team would like to purchase one or more of the same item, please see Professor Love to request a bulk purchase that may be paid for by department funds.

COMPETITION RULES

- Races will be run using photogate timers to measure time (to the nearest millisecond) within a predetermined section at the end of the race track. By knowing the distance between two photogates, average velocity of each solar car can be calculated.
- One team member will be positioned at the starting line and another member at the finish line (to catch his/her car).
- Each vehicle will be allowed ten (10) trials to meet the minimum requirements and to achieve any "categories of excellence" (speed, power, accuracy).
- The vehicle will start from behind a starting line with all wheels touching the track. The solar panel will be covered by an opaque sheet which will be held above the panel by a member of the race team to block the sunlight. When the start signal is given, the opaque sheet will be removed to expose the solar panel to sunlight (and to allow the solar PV panel to start producing electricity to power the DC motor).
- Once the race has begun, team members are not allowed to touch their vehicle or be on the race lanes until their vehicle has crossed the finish line. Pushing the vehicle at the start of the race will result in disqualification.
- Any car that leaves its lane will be disqualified from that trial. If a car leaving its lane interferes with any other cars, those cars whose run was disrupted will be allowed an additional opportunity to run.
- Loss of payload during a race will result in disqualification from the trial in question. If the loss of payload interferes with any other cars, those cars whose run was disrupted will be allowed an additional opportunity to run.

CATEGORIES OF EXCELLENCE

In addition to meeting the minimum requirement, additional points are given for excellence. The "categories of excellence" for additional points are:

- Speed – be one of the top two (2) fastest vehicles.
- Power – points are earned if your vehicle can carry 4 times the load or more (carry at least 4 Tupperware water containers a distance of 30 feet).
- Design – be the top vehicle that is voted the most exceptional in either creativity, workmanship, or original design (as determined by peer voting).
- Accuracy – be one of the top two (2) vehicles that can travel in the straightest line unassisted by active steering mechanisms within the boundaries of a straight 30 foot lane.

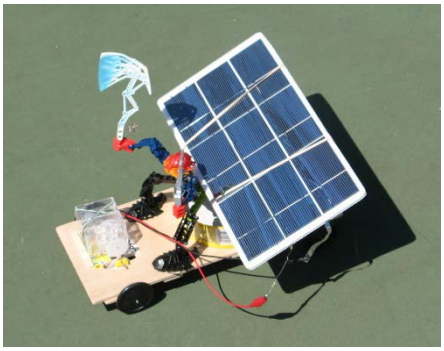

Figure 4. Professor Love's solar car.

GRADING CRITERIA

- Test Day/Competition Days = 20% of final course grade (100 pts total).
  - ✓ 30 pts for a vehicle that runs on Test Day, June 6.
  - ✓ 50 pts for a vehicle that successfully meets the minimum performance criteria (carry 1 Tupperware container of water 30 feet on a flat surface) on all Competition Days, June 18, June 19 & June 20.
  - ✓ Additional 10 pts for each "category of excellence" earned during the Competition Days.
- Oral Team Presentation = 5% of final course grade (100 pts total).
- Final Written Technical Report = 10% of final course grade (100 pts total).

WRITTEN REPORT – DUE AT THE FINAL EXAM

Submit one 10+ page typewritten technical report per design team, written in third person point of view (1st person point of view is not appropriate for technical reports). Your report will include at a minimum: the edited synthesis of the relevant design assignments that you will complete each week during the semester, an AutoCAD and/or Solidworks collection of dimensioned drawings that adequately and thoroughly communicates your final design, an itemized Bill of Materials with a list of all components and materials used including cost per item, and copies of all receipts of items purchased (not more than $20). More details will follow.

INDIVIDUAL MEMO TO PROFESSOR LOVE

Every individual member of the design team should type a confidential memo to Professor Love to be sealed in an envelope and submitted with your team's report. In this memo, discuss your personal experience with the solar car design project, identifying what you learned during this project, in terms of new skills (for example, soldering, drive train design, solar photovoltaic performance) and in terms of personal accomplishments (for example, working with others, time management strategies). Also include any recommendations for future improvements for the project, either in terms of design specifications, competition rules, team assignments, lab resources, etc..