Engineering 1N
THE NATURE OF ENGINEERING
Mechanical Dissection Project

Preliminary Report due November 12, 2002
Final Report and Instruction Manual due 3:30 pm, November 26, 2002

The Goals: The goals of this project include providing you with the opportunity to: 1) discover the internal structure and the functions of the components of an electromechanical device, via dissection, or as it is sometimes called, reverse engineering; 2) develop insight into the engineering design and manufacture of this device; 3) think through the process of device assembly; 4) communicate your newfound knowledge in both a report and an instruction manual; and 5) work closely in a small group.

The Project: For this project you will work in an assigned team of two (2) students. Each team will receive an electromechanical device from this list or a close equivalent:

- Sunbeam® Model 3108-8 Adjustable Height Can Opener with Electric Knife Sharpener or approximate equivalent
- Proctor-Silex® ChopMaster™ 72500 Food Chopper
- Hamilton Beach® EasySlice™ 74150 Electric Knife
- 092 03 0008 Made in China 250PSI Portable 12 Volt Air Compressor
- Rival® Model HM450 Five Speed Hand Mixer

Team assignments are as follows:

<table>
<thead>
<tr>
<th>Team</th>
<th>Members</th>
<th>Appliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Carlos Cabrera, ccabrera@stanford, Marisa Schottelkorb, marisas@stanford</td>
<td>Hand mixer</td>
</tr>
<tr>
<td>B</td>
<td>Alex Chan, alexch@stanford, Caitlin Quance, cquance@stanford</td>
<td>Hand mixer</td>
</tr>
<tr>
<td>C</td>
<td>Ellen Gray, etgray@stanford, Mike Zhang, mzhang24@stanford</td>
<td>Hand mixer</td>
</tr>
<tr>
<td>D</td>
<td>Joanna Gubman, <a href="mailto:turtlegyrl@lycos.com">turtlegyrl@lycos.com</a>, Danny Tarlow, dtarlow@stanford</td>
<td>Can opener</td>
</tr>
<tr>
<td>E</td>
<td>Emily Gustafson, emily.gustafson@stanford, Jessica Kozak, jkozak@stanford</td>
<td>Can opener</td>
</tr>
<tr>
<td>F</td>
<td>Kari Lee, karilee@stanford, Lara Peterson, larap@stanford</td>
<td>Food chopper</td>
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I would like each team to:

1) Carefully examine your device externally to determine how it is operated and what it does. Then, prior to any disassembly, prepare a one-page report describing how you think your device works. In other words, what do you think is inside your appliance and how does what is inside it work together to allow the appliance to operate in the way it does? Submit this one-page speculation as a preliminary report on or before Tuesday, November 12, 2002.

2) Disassemble (dissect) carefully your device into its component parts. Do not disassemble components which cannot be reassembled with basic tools (e.g., screwdrivers, wrenches, pliers). In other words, do not drill out rivets, break plastic or metal retainers, disassemble circuit boards, or unwind the copper wire from electric motors, for example. On the other hand, don’t be dissuaded from disassembly until you have looked carefully for retaining clips or other less obvious assembly methods. You will be evaluated on the completeness of your disassembly.

Watch out for sharp edges (particularly with the food chopper, knife, and can opener), grease, spring-loaded parts that may go flying, etc. Also, do NOT plug in your device once you have started to dissect it. If you want to see it in operation, do that prior to dissection.

We have available some basic tools to assist you in dissection, including adjustable wrenches (crescent wrenches), needle-nose pliers, and flat- and Phillips-head screwdrivers. You may check these out from Jill in Terman M-13. You should find these adequate for the task. You are of course welcome to use your own tools, if you or a friend should have some. If you are uncertain about or unfamiliar with the use of a particular tool, please ask for assistance, especially if there is risk of damage. For example, use of the incorrect size of Phillips head screwdriver can quickly destroy the head of a screw.

3) Prepare a document (report) that identifies each component and its function in the context of the operation of the appliance. Describing something as a gear or a switch, for example, does not explain its function. What does it do? Multiple identical components having the same function may be described as one, e.g., “... four 1” brass machine screws: attach gear assembly to body ...”

In addition, describe how the components operate together to make the device work, e.g., “... Motor A turns Gear B attached to Cutter C ...” The basic questions
you should ask yourself include: “How does it work?”, “Why is this particular component here?”, and “How does this part interact with other parts in the device?” You might also find it helpful to ask yourself “What would happen if this part were not included?”, and “Could some other type of component perform the same function?”

4) Prepare an instruction manual for reassembling your device. On the due date, you will bring your disassembled device to class with you, along with your report and your manual. These materials will be passed to a team of students who have dissected a different device. That team will be required to reassemble your device during class using your instruction manual. They will then evaluate your manual. (A copy of the evaluation form is attached.) Therefore, your goals in preparing the manual are clear: provide all of the information necessary for a group of 2 students to reassemble (quickly and completely) your device into a working can opener, food chopper, compressor, electric knife, hand mixer, etc. You may use text, drawings, photos, whatever you think will work in a printed document. Your manual may not be computer-based or video-based. It must be a paper document. In addition, you will not be permitted to coach the reassembly team during reassembly. Your instruction manual must function independently of any intervention on your part.

Disassembled components may not have labels written on or attached to the component, nor may they be bundled with or attached to other components, i.e., screws cannot be provided loosely sitting in their holes. You may bundle multiple identical small components, e.g., four identical machine screws, together, e.g., in a plastic bag (I have a large supply—just ask), but the bag may not be labeled. In other words, all labeling must be accomplished via the printed instruction manual.

Some Other Rules:

Please word-process your text.
You may single-space your text if you think that will be more effective, but whether single- or double-spaced, please use a 12-point font, and leave a 2.5-cm left and right margin.
Drawings may be prepared by hand. All drawings and figures should be numbered sequentially and referenced by number in the text.
Please place your names on each page, along with the page number.
Please staple pages together. Please do not put them in a binder.

You are welcome to discuss your appliance, its components and their functions, and your documents, outside of your team with anyone who is not in the seminar. In fact, you may want to test your reassembly instructions on some of your unsuspecting friends. However, the spirit of this assignment requires that you NOT invest any time prior to class on reassembly day in studying the structure and components of the devices which you are not dissecting, or in assisting teams who are working on different appliances.

Finally, your documents (one set per team) should be your own—you should prepare
your own text and graphics, acknowledging significant assistance where appropriate.
Reassembly Team: ________________________________  Instruction Manual Authors: ________________________________

Use this form to rate the disassembly team’s instruction manual. Use the following scale for your evaluation:

<table>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td></td>
<td>Inadequate</td>
<td>Somewhat Less Than Adequate</td>
<td>Adequate</td>
<td>Better Than Adequate, User Friendly</td>
<td>Exceptional</td>
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1) __________  **COMPLETENESS**

Does the instruction manual contain all the instructions needed to assemble the device?

2) __________  **ORGANIZATION**

How well is the instruction manual organized? Are headers used effectively? Is the instruction manual laid out well? Do the assembly instructions progress in a logical manner?

3) __________  **DIAGRAMS/FIGURES/TABLES**

Are diagrams, figures, and tables used to clarify the assembly instructions? Are they clear and helpful? Do the diagrams/figures/tables complement the text?
4) Parts Identification
   Is it easy to identify parts referenced in the manual?

5) Descriptive Language
   Does the instruction manual use succinct, descriptive terms and language? Do you feel the instruction manual conveys the assembly instructions efficiently?

6) Definition of Terms
   How well does the instruction manual define any technical terms?

7) Overall
   Please give your overall rating of the instruction manual.

Additional Comments and Elaboration on Ratings (Optional):

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