Clemson-FujiFilm Partnership for Introducing Design to Freshmen

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Abstract

Details of a partnership between Clemson University’s General Engineering program and FujiFilm’s Greenwood facility provide an excellent example of an industry-sponsored design project. Two years of experience with students engaged in design projects based on making modifications to Fuji QuickSnap cameras have yielded creative results, and descriptions and photos of the more interesting designs are available. The grading criteria for both the students’ class grade and a design competition judged by a panel of Fuji employees will be included.

The next step in the evolution of this design project will be moving from a design evaluation that is product-based to a design evaluation that evaluates a team’s design process as well. This approach will improve the quality of the design education that students receive and could result in the easier-to-measure objective of improving student design scores.

The Fuji Film Greenwood Facility

Fuji Photo Film, Inc., opened the Greenwood facility in 1989 to manufacture presensitized plates and related products used in offset printing. Greenwood expanded to add plants to manufacture videotapes in 1991, QuickSnap one-time-use cameras in 1995, color photographic paper in 1996. Facilities for 35mm color film finishing and packaging, graphic arts film finishing, and 35mm film production were added in 1997. In 1999, FujiFilm began coating data storage media in Greenwood and opened the Greenwood Research Laboratories. Greenwood’s most recent additions were a medical imaging products facility and a second color film and photographic paper factory added in 2001. The current site, with 8 plants, a research facility, and Fuji’s largest automated distribution center in the world, is an educationally rich environment for engineering students. Fuji Film Greenwood is a participant in Clemson’s Cooperative Education (co-op) program.

Clemson and its General Engineering curriculum

Clemson University is a land-grant institution located in rural upstate South Carolina. Its population of approximately 14,000 undergraduates is drawn largely (65%) from in-state high schools. Originally a technical school, Clemson is still considered to be largely technically oriented, and the College of Engineering and Science is the largest college in the University. Clemson’s General Engineering program has coordinated a common first-year engineering curriculum since 1985. The program was known as Freshman Engineering until 1993.

The first semester freshman course, Introduction to Engineering Disciplines and Skills, focuses on providing students with an understanding of the various majors in the College of Engineering
and Science. This course is a descendant of the department’s Introduction to Engineering and Science course, which is described in greater detail elsewhere. One of the course objectives is to give students an introduction to the engineering design process, and a wide variety of design projects have been used to meet this objective.

The Clemson-FujiFilm Partnership

In fall 2002, Henry Wilson of FujiFilm contacted Clemson’s General Engineering with a request to speak to the engineering freshman. Time pressures of other planned course content made it impossible to accommodate the request, but the conversation led to a project partnership. Clemson’s fall 2002 General Engineering students, as one of three design projects in the term, were asked to build a device that would cause a Fuji QuickSnap camera to take a picture 20 seconds after the device was activated (no intervention was allowed during this 20 seconds). This was one of three design-build projects during the semester, and students generally met the performance specifications. Project testing was a hectic seven-hour-long ordeal during which the projects were evaluated both for their performance and according to a design rubric. This was identified as requiring improvement.

A more ambitious project was introduced as a semester project in Fall 2003. Students were instructed to outfit a Fuji QuickSnap camera so that it would be coin operated. The goals of the project were to design a build a device that activates the camera 20 seconds after one dollar in coins is deposited. The device is to give a visual or audible warning 2-5 seconds before the picture is taken. While full credit required that the device reset so that a wound camera would activate if it was triggered again, bonus points were assessed to devices that fully reset including winding the camera. A bonus was also given to devices that could recognize a “gold” dollar coin and activate immediately. Additional project specifications restrict the cost of the design ($20), the number of trials without penalty (2), the size of the design (if stored in our facility, it must fit in our storage boxes).

In addition to the generous contribution of employee time to judge projects, Fuji Film donated the QuickSnap cameras (valued at $1400 in 2003), T-shirts for finalists (only $450 because a delay resulted in a price reduction), Outback gift certificates for the winners in each section ($1200), and prize packages for the grand prize winners ($1800 total—each member of the winning team received a Fuji A310 digital camera and a Clemson Care Package).

Evaluation of Design Projects

For the purposes of classroom grading, the projects are graded based on their performance against the established criteria as shown in the Design Objectives / Grading Sheet that is appended to this paper. It is hoped that future design-build projects are able to incorporate an assessment of the design process into the grading scheme. The greater challenge will be adding design instruction to the semester curriculum. The Fuji judges use a design rubric as shown in, CES 102 Clemson University / Fuji Greenwood Coin-Operated Camera Project judging criteria also appended to this paper.
Preliminary testing was conducted to ensure students got an early start on the project. By midterm, students had to have implemented a coin-triggered action and at least a 5-second delay (practice for the 20-second delay required in the final project).

To reduce the chaos during final judging, General Engineering faculty evaluated the projects for a course grade during the previous week. For a project to be eligible for the finals judged by Fuji, a General Engineering faculty member had to recommend the project to the finals.

Students participating in the project each fill out a “Distribution of Effort” form that communicates their perspective as to how the work of the team was divided. This is an individual, confidential exercise that is used, with the application of the faculty member’s judgment, to sort out team conflicts when they occur and to distribute the grade fairly in cases when the workload was unfairly borne by a subset of the team. Simply using a peer evaluation instrument is a reminder to the students that they are individually accountable for the success of the project. A synopsis of a variety of approaches to peer evaluation is available elsewhere in these proceedings.6

Acknowledgements

Clemson’s General Engineering faculty and students are grateful to Fuji Film of Greenwood for their enthusiastic contribution of their time and prizes. Special thanks to Henry Wilson, who has coordinated Fuji’s participation in this collaborative effort.

Author Biography

MATTHEW W. OHLAND is an Assistant Professor in Clemson University’s General Engineering program and is the President of Tau Beta Pi, the national engineering honor society. He received his Ph.D. in Civil Engineering with a minor in Education from the University of Florida in 1996. Previously, he served as Assistant Director of the NSF-sponsored SUCCEED Engineering Education Coalition. His research is primarily in freshman programs and educational assessment.

References

Design Objectives / Grading Sheet

CES 102 FALL 2003 DESIGN PROJECT
MAKING A COIN-OPERATED CAMERA

(Names, Team number, Section, and Grade written on reverse.)

Each team will receive two Fuji QuickSnap Single Use Cameras. Your goal is to install a device that costs less than $20 that causes the camera to take a picture 20 seconds after one dollar in coins is inserted into a coin slot. The criteria below will be used to evaluate your project. After inserting the coins, you cannot interact in any way with the camera or your apparatus.

Preliminary testing appointments will be available as shown on the course schedule.

Coins trigger an action ___ (10 pts.) Action has a 5-second delay ___ (10 pts.)

<table>
<thead>
<tr>
<th>Specifications</th>
<th>20 pts each</th>
<th>10 pts each</th>
<th>5 pts each</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Camera activates after multiple coins are inserted</td>
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<tr>
<td>2. Camera activates after at least one dollar in coins is inserted</td>
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<tr>
<td>3. Camera activates after exactly one dollar in coins is inserted</td>
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<tr>
<td>4. Camera activates if a single “gold” dollar is inserted</td>
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<tr>
<td>5. Camera activates at least 5-seconds after coins are inserted</td>
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<tr>
<td>6. Camera activates at least 10-seconds after coins are inserted</td>
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<tr>
<td>7. Camera activates 19 to 21 seconds after coins are inserted</td>
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<tr>
<td>8. Device gives a warning 2-5 seconds before camera activation</td>
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<tr>
<td>9. Device resets to take another picture if the camera is wound</td>
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<tr>
<td>10. Device fully resets by winding the camera</td>
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Summation of Criteria

Two trials are permitted. Each subsequent trial results in a 5-point deduction from the total score.

Number of trials: 1 2 3 (-5 points) 4 (-10 points) 5 (-15 points)

Overall Grade: _________

If you want to keep your project in the General Engineering project storage facility, it must be contained entirely within your project box with the lid on. Projects may not use any 110 Volt power source or combustion.

Additional design goals for contest sponsored by Fuji Greenwood

While the above criteria describe the grading criteria, additional criteria will be judged by employees of Fuji Greenwood in competition for prizes that will be announced later. For this competition, projects will be judged according to these additional criteria:

- Design Simplicity
- Maintainability
- Originality
- Craftsmanship
- Safety / ergonomics
- Aesthetics
## CES 102 Clemson University / Fuji Greenwood Coin-Operated Camera Project judging criteria

<table>
<thead>
<tr>
<th></th>
<th>Design Simplicity</th>
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<th>Originality</th>
<th>Craftsmanship</th>
<th>Safety / ergonomics</th>
<th>Aesthetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Many moving parts, elements that do not serve a function, lots of material, one-of-a-kind parts</td>
<td>Failure requires replacement, lots of adjustment to test, many fastener types</td>
<td>Lots of others like it, uninspiring.</td>
<td>Poor construction, sloppy visual appearance, no attention to detail</td>
<td>Sharp edges, unshielded moving parts, polluting, operation awkward or dangerous</td>
<td>Unimproved or ragged, single drab color</td>
</tr>
<tr>
<td>2</td>
<td>Extra moving parts, useless elements, excess material, uncommon parts</td>
<td>Difficult to repair, some adjustment needed to test, fastener variety</td>
<td>Relatively common design, doesn’t particularly capture the imagination</td>
<td>Some construction irregularities; appearance detracts from overall work</td>
<td>Some safety issues still present (severe ones mitigated), difficult to use</td>
<td>Improvements attempted, but not coherent or attractive</td>
</tr>
<tr>
<td>3</td>
<td>Reasonable number of moving parts, use of elements, use of common material</td>
<td>Regular maintenance and fastener use is reasonable</td>
<td>Some interesting elements, but design generally unremarkable</td>
<td>No noticeable construction flaws or distracting visual appearance</td>
<td>Acceptably safe with mitigation, operation requires care / explanation</td>
<td>Improvements add to appearance, but not noteworthy</td>
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<tr>
<td>4</td>
<td>Reduced number of moving parts, most elements functional, made from a few common materials</td>
<td>Designed for maintenance, fasteners used carefully</td>
<td>Intriguing design, similar to other designs, but with an interesting variation</td>
<td>Attention to detail, well constructed, appearance adds to the quality of the design</td>
<td>Reasonably safe with no mitigation, comfortable and requires little explanation</td>
<td>Well-painted, but color choice unrelated to Clemson or Fuji colors</td>
</tr>
<tr>
<td>5</td>
<td>Notably simple design / execution; few or no moving parts, all elements are functional; standard sizes of common materials</td>
<td>Maintenance is simple or unneeded, few / one type of fastener</td>
<td>Unexpected, attention getting, new approach one of a kind design</td>
<td>Particularly attractive; form follows function</td>
<td>Inherently safe with no mitigation, operation is particularly well-fitted, requires no explanation</td>
<td>Nicely painted, decorated attractively in Clemson or Fuji colors</td>
</tr>
</tbody>
</table>

**Special comments**

Section # ______ Team # ______ Performance score ________

Team members_____________________________________________________________________________________________

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