Protecting/Stealing the Trillion-Dollar Bill: Instructor Guide

Title

Protecting/Stealing the Trillion-Dollar Bill

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Discipline

Mechanical Engineering

Target Audience

Advanced, majors

Keywords

Mechatronics, sensors, strain gauge

Length of Time/Staging

Three weeks. Initial problem with report after two weeks, then secondary problem with an additional week.

Abstract

This problem encourages students to investigate sensor integration as part of a mechatronics course in mechanical engineering. The intended sensor is a strain gauge, but other designs will work.

The key features of the problem include:

1. Sensor selection based on problem specifications,
2. Sensor integration which may include amplification, RC filters, A/D conversion.
3. Consideration of environmental, budgetary, and social factors.
4. Analysis of an existing sensor design.

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5/16/2014

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2/5/2015

Format of Delivery

Students are divided into teams of three to four students each. Each team is given the initial assignment, “Protecting the Trillion Dollar Bill.”

Following completion of the initial design, students are informed that Mr. Burns has selected a competing design. The secondary assignment, “Stealing the Trillion Dollar Bill,” is assigned with a different team's initial design report serving as the competing team.

Instructor Resources

Undisclosed Extras

- The security system is analogous to a bathroom scale. This would be a good starting point for investigation.
- The security system will need an option to arm and disarm for installation and removal. These options should be protected from the common rabble.
- Despite Mr. Burns’ specifications, the security system should also alert museum security and the police.
- The Springsonian Museum does not run the heat/AC after hours. The temperature will fluctuate with the season and may be above or below normal.
- The Springsonian Museum can provide electrical power but little else.
- Does the system register higher than normal mass? A hooligan could add mass and then remove the crystal block.
- Does the system register directional changes? A hooligan could pull an “Indiana Jones” switch.

Assessment Strategies

See the assessment pdf in the problem folder.

Solution Notes

There are many workable solutions to the problem. The "best" solution (as determined by the author) is to treat the problem as a bathroom scale with four load cells at the corners.