PROPOSAL ABSTRACT: GOOD EXAMPLE

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This proposal describes the construction of a prototype $20 oscilloscope that students will use in grades five through twelve to learn about electronics.

Opportunities for students in K-12 grades to learn about electrical engineering are currently limited by the cost, size, and complexity of available educational materials. There are shortcomings for kits, instruments, and instructional texts. Typical kits are one-time use, lack mathematical problem-solving content, and cost $40 or more. An example would be a solar-powered car or sound-activated alarm. Typical instruments are large, designed with an overabundance of features, and cost $200 or more. An example would be a handheld oscilloscope. Typical instructional texts are paperback books with cartoon drawings of projects, use light-duty materials such as paper or tinfoil, cost about $5 each plus materials, and use materials that are consumed. Thus, existing educational materials are poorly suited to teaching individual students about engineering at a reasonable cost.

The proposed solution to the above shortcomings is to create reusable kits, companion books that introduce mathematical ideas associated with circuits, and measuring instruments that are small enough and inexpensive enough to distribute to each student. The $20 simplified oscilloscope described here will meet the latter of these needs—that of making circuit measurements.

The $20 oscilloscope will consist of the following components:
1) 8-bit microcontroller with 8k bytes of program memory, 512 bytes of RAM, 512 bytes of EEPROM, and 10-bit A/D.
2) LCD display, 128 x 32 pixel, monochrome, LED backlight, with driver circuitry
3) 3 binding posts
4) 2 pushbuttons to control functions
5) 3V battery holder
6) PC board and miscellaneous components
7) 2 min-hook test leads

Since the clock speed of the microcontroller will be relatively slow, the prototype will be built on a protoboard and then in wire-wrap form.

The $20 oscilloscope will have the following functions:
1) Measure and display a static voltage, updated every 1 second
2) Measure the amplitude and phase shift of a 1 kHz sinusoid
3) Output a 3V sinusoid at a fixed frequency of 1 kHz

The complete cost of creating the prototypes is estimated to be $500, with the major expenses being the microcontroller development system, the fabrication of the PC board, and the wire-wrap parts. The prototypes will be assembled and tested in the ECE Department labs, eliminating facility costs. In mass production, the cost of the instrument is expected to be $20.

The time to complete the two prototypes is estimated at 9 months, (6 months 1st prototype, 3 months 2nd prototype).