Designing Earthquakes for a Low-Cost Shake Table

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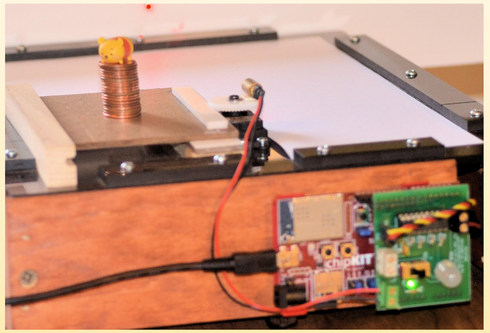
Build a Structure Which Can Survive a Richter Magnitude 5 Earthquake

-- Then Design a Magnitude 4 Earthquake to *Destroy it*



Overview

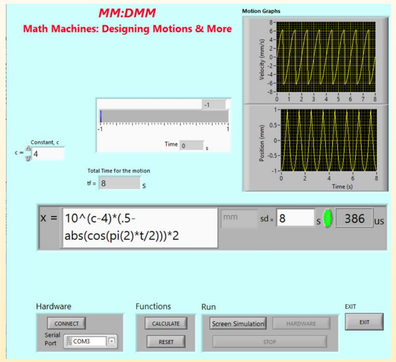
With backgrounds in physics, math and engineering, we have worked together for 22+ years, developing ***brief*** classroom activities which:

1. Engage students in ***thinking algebraically***, not just in solving equations,
2. Help teach key physics concepts, such as ***position, velocity and acceleration***, and
3. Engage students in using rigorous physics and math to complete ***engineering-style tasks***.

Earthquakes present a valuable teaching opportunity in that the original Richter Magnitude scale is based on the maximum **displacement** produced by a quake, while engineering building standards are based primarily on the maximum likely **acceleration**.

Key Tools Developed by Math Machines

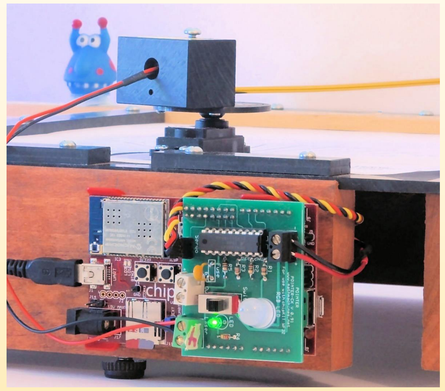
An Algebra-Based User Interface



Distributed as a free LabVIEW executable, the interface allows learners to program physical motions directly with Excel-like algebraic formulas. Functions can specify either x = f(t) or v= f(t)

The software can also replay (in original or modified form) data sets such as the waveforms recorded by digital seismometers..

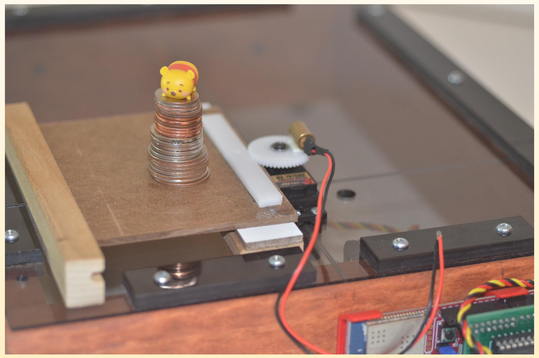
Sketch and Shield for an Arduino-Style Board with SD Card



We use a Digilent chipKIT WF32 with a micro-SD card, a shield and a sketch that let users store and rapidly play very large sets of position (or RGB color) data.

The sketch can control a hobby servo motor, a stepper motor, a low-power laser or an RGB LED.

Multi-Use, Low-Cost Hardware



Our “Function Plane” is simply a servo motor mounted with the chipKIT control board on a wood and plastic box.

For earthquake activities, we add a rack and pinion system to drive a movable platform from the servo motor

We Want to Share

Coming to *The Physics Teacher* this Winter:
“Math Machines: Using Actuators in Physics Classes"

Free software, building instructions, curriculum materials, videos and more are available at www.mathmachines.net or fred.thomas@mathmachines.net

Learning with Math Machines is a not-for-profit, 501(c)(3) charitable organization with a mission to improve the quality of mathematical education, enhance the transfer of mathematical thinking into other classes, and increase students’ ability to apply rigorous mathematics outside the classroom.

Notes

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