Using Wide-Spread Collaboration to Motivate Innovation and Creativity

Award Number: IIS-0757455

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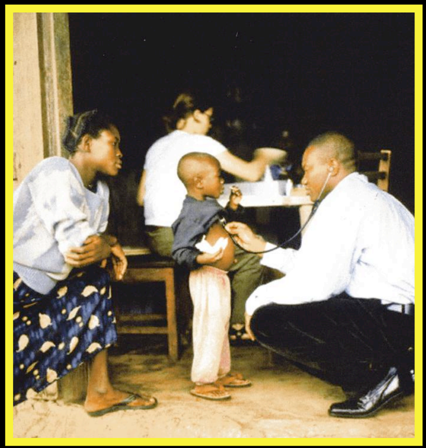
Center for Engineering Education and Outreach
Tufts University School of Engineering

Creative IT Workshop – January 15 & 16, 2009

Center for Engineering Education and Outreach
Tufts University School of Engineering

http://www.ceeo.tufts.edu

Why Engineering Education?

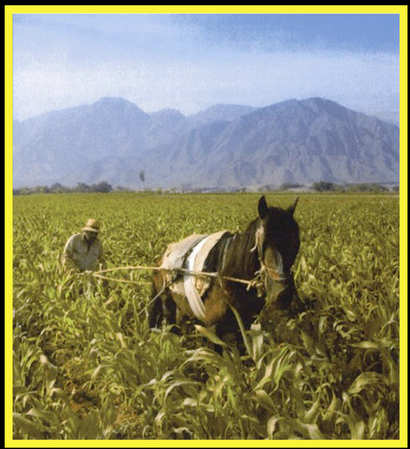


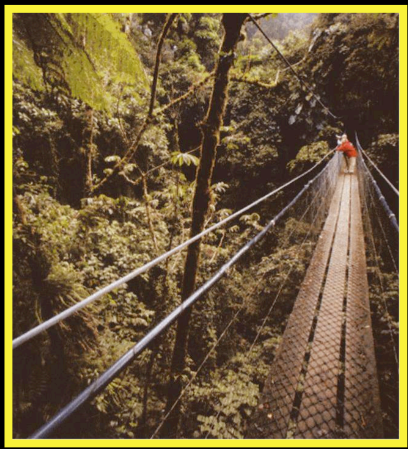
IF we want a future with…

- abundant clean energy
- the last of epidemics
- environmental stability
- food enough for all

We NEED students…

- excited about math & science
- engaged in continuous learning
- capable of innovative problem solving
- aware of engineering's importance to improving the future!





Improving Education Through Engineering

Center for Engineering Education and Outreach

Outreach

- LEGO Engineering Conferences
- STOMP Network
- Workshops

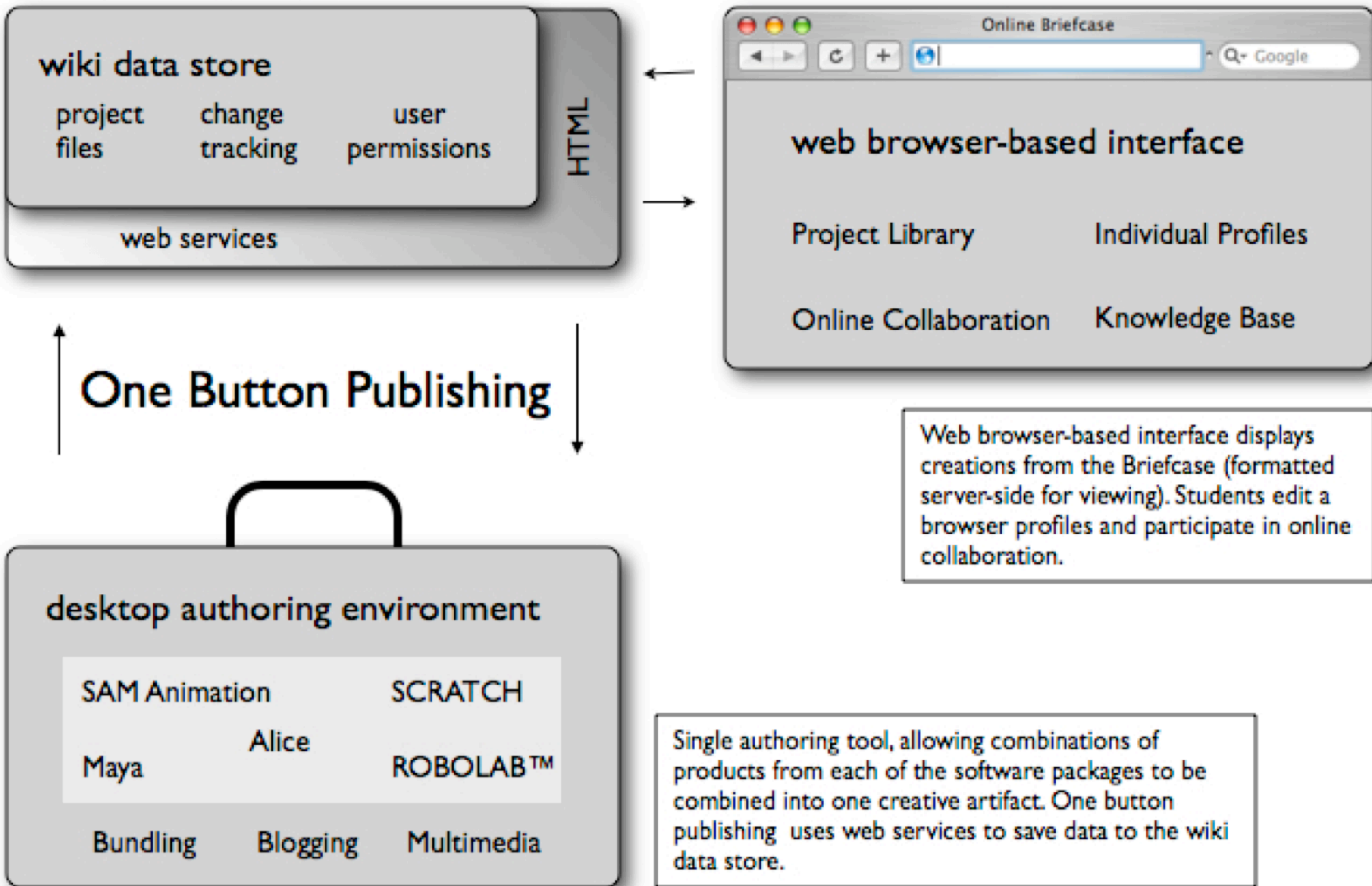
Tools and Content Development

- Software
- Websites
- Print-based

Research

- Methodologies
- Curriculum
- Tools

The Briefcase



Power of the Digital Briefcase

- Curriculum, content, technology and documentation all collected, organized and presented in one location

Curriculum Content:

- Activity description
- Procedural details
- Instructional text
- Educational pictures and movies

Project Development:

- Planning algorithms, schematics, and steps
- Experimentation
- Design choices and decisions
- Process feedback

Final Documentation:

- Program code
- Pictures/movies
- Text/audio descriptions
- Collected data
- Analyzed graphs
- Grades/comments

Distinct Advantages of Our Model

- Flexible data entry environment, encompassing multiple representations
- Varied teacher customization (to adapt for language, classroom, learning disabilities, etc)
- Third party and user defined plug-in inclusion
- Simultaneous inclusion of multiple software programming platforms
- Direct hardware connection with real-time interaction

Collaboration

In the classroom		Across the globe...
Curriculum **Activities** **Concepts**	**Curriculum** **Activities** **Concepts**	**Curriculum** **Activities** **Concepts**
SOFTWARE	**SOFTWARE**	**SOFTWARE**
HARDWARE	**HARDWARE**	**HARDWARE**

Digital Interactive Notebooks

1. Show that for a single particle with constant mass the equation of motion implies the following differential equation for the kinetic energy:

$$\frac{dT}{dt} = \mathbf{F} \cdot \mathbf{v},$$

while if the mass varies with time the corresponding equation is

$$\frac{d(mT)}{dt} = \mathbf{F} \cdot \mathbf{p}.$$

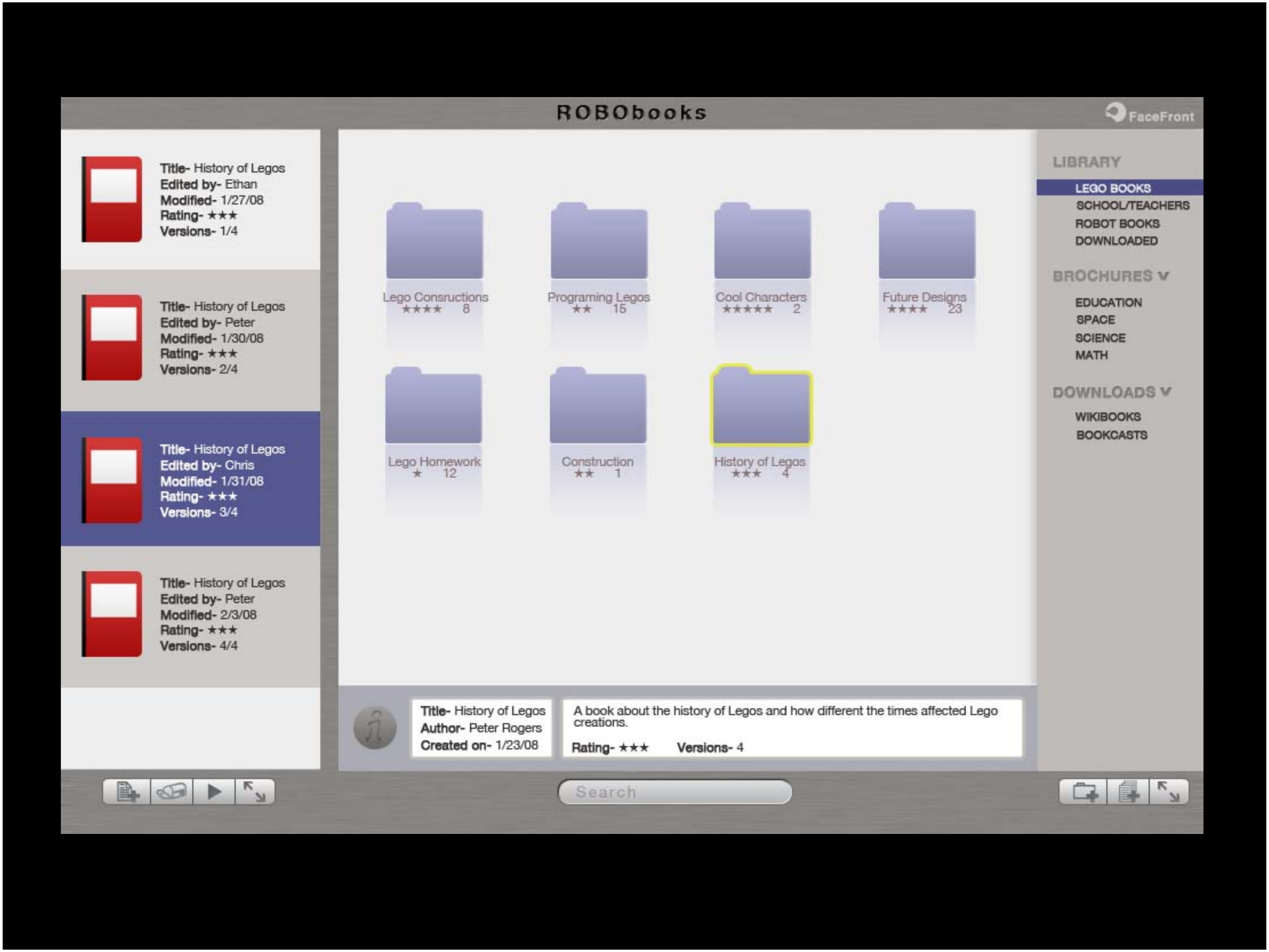
2. Prove that the magnitude R of the position vector for the center of mass from an arbitrary origin is given by the equation

$$M^2R^2 = M\sum_i m_i r_i^2 - \frac{1}{2}\sum_{i,j} m_i m_j r_{ij}^2.$$

3. Suppose a system of two particles is known to obey the equations of motion, Eqs. (1.22) and (1.26). From the equations of the motion of the individual particles show that the internal forces between particles satisfy both the weak and the strong laws of action and reaction. The argument may be generalized to a system with arbitrary number of particles, thus proving the converse of the arguments leading to Eqs. (1.22) and (1.26).

$$M\frac{d^2\mathbf{R}}{dt^2} = \sum_i \mathbf{F}_i^{(e)} = \mathbf{F}^{(e)}, \qquad (1.22)$$

$$\frac{d\mathbf{L}}{dt} = \mathbf{N}^{(e)}. \qquad \text{(external torque)} \qquad (1.26)$$


ROBObooks
FaceFront
Title- History of Legos
Edited by- Ethan
Modified- 1/27/08
Rating- ★★★
Versions- 1/4
Title- History of Legos
Edited by- Peter
Modified- 1/30/08
Rating- ★★★
Versions- 2/4
Title- History of Legos
Edited by- Chris
Modified- 1/31/08
Rating- ★★★
Versions- 3/4
Title- History of Legos
Edited by- Peter
Modified- 2/3/08
Rating- ★★★
Versions- 4/4
Lego Consructions ★★★★ 8
Programing Legos ★★ 15
Cool Characters ★★★★★ 2
Future Designs ★★★★ 23
Lego Homework ★ 12
Construction ★★ 1
History of Legos ★★★ 4
LIBRARY
LEGO BOOKS
SCHOOL/TEACHERS
ROBOT BOOKS
DOWNLOADED
BROCHURES v
EDUCATION
SPACE
SCIENCE
MATH
DOWNLOADS v
WIKIBOOKS
BOOKCASTS
Title- History of Legos
Author- Peter Rogers
Created on- 1/23/08
A book about the history of Legos and how different the times affected Lego creations.
Rating- ★★★
Versions- 4
Search

Musical Instrument

Assignment Documentation

Fill in the areas with the requested information. The next page displays pictures of your creation.

Enter your instrument's name:

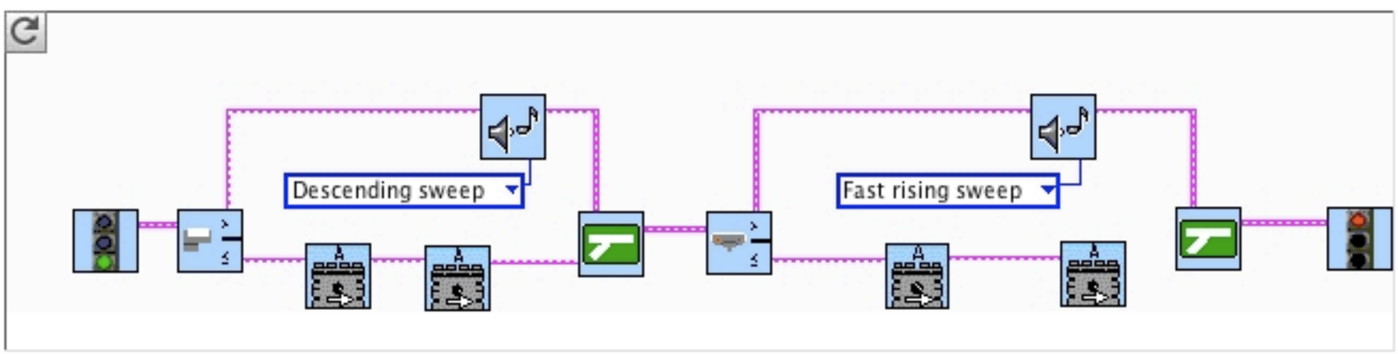
Enter your group members:

Describe your conceptual design of your intrument:

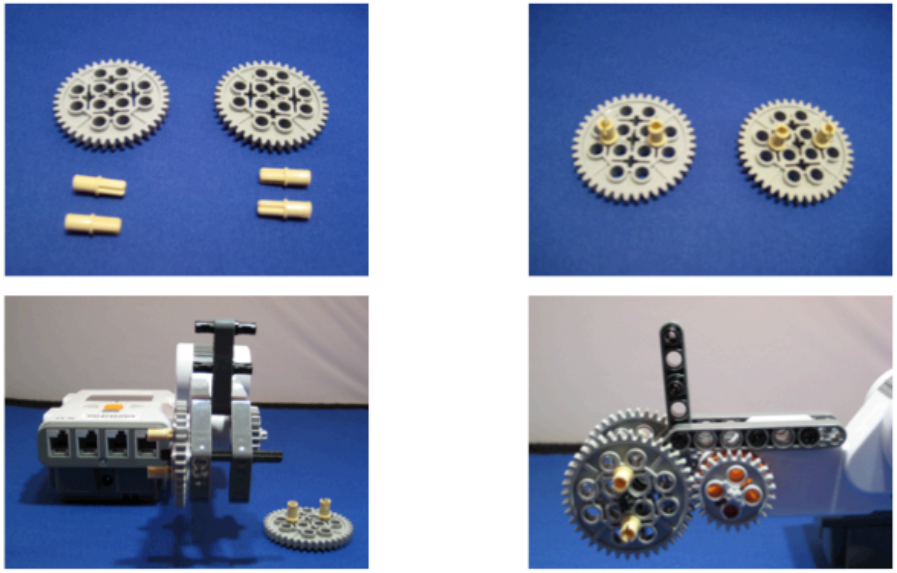
Give details of your technical solution (mechanical/programming

Plays at least three notes?
(yes, sort-of, no)

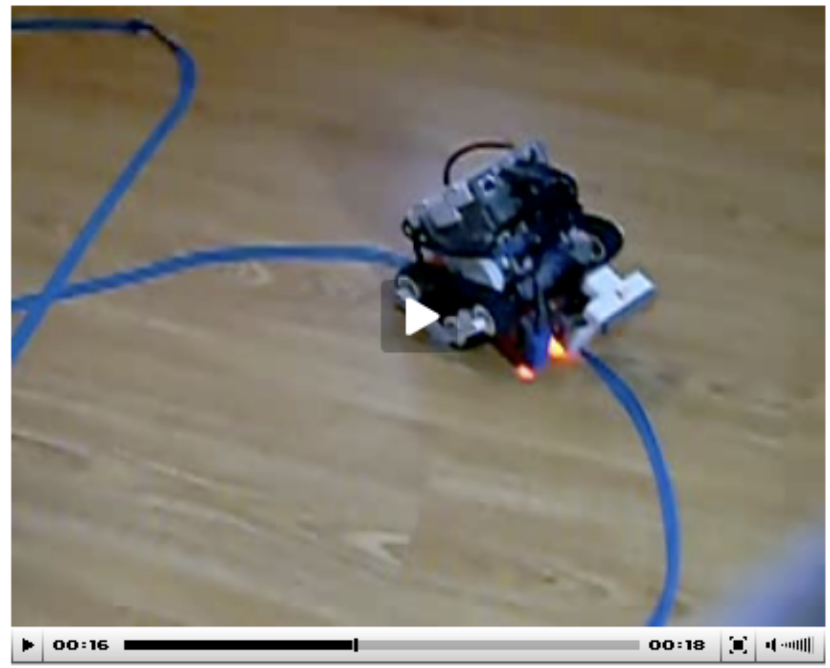
Recognizable tune?
(yes, sort-of, no)



<< 10 / 17 >>



Here are two pictures of the final creation:



Video courtesy of **Laurens200**.

Broadcast Yourself™

Sound Trigger

Class Experiment

After viewing each experiment design from all the other groups, work as a class to design the final experiment.

Describe below the final process on which everyone agreed you will be using. Then take some pictures of the final set-up once you have created it.

TitleSimple.jpg

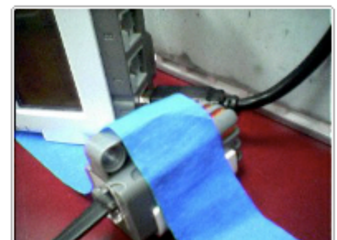
Sound Trigger

Class Experiment

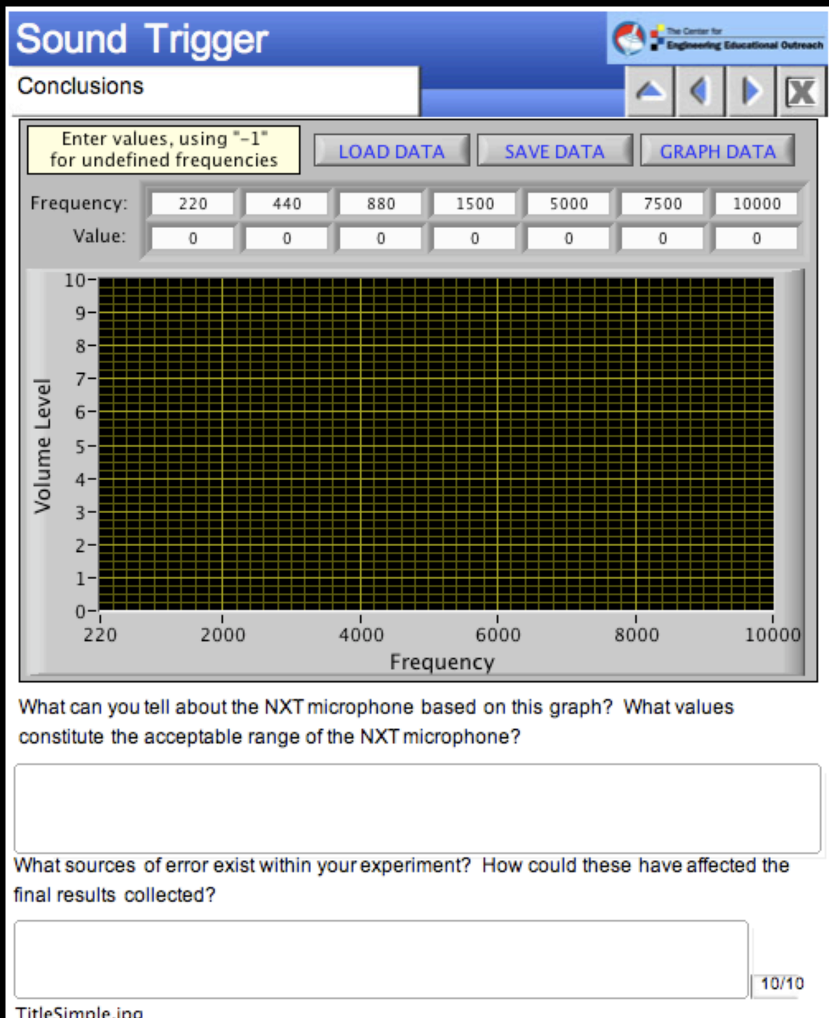
After viewing each experiment design from all the other groups, work as a class to design the final experiment.

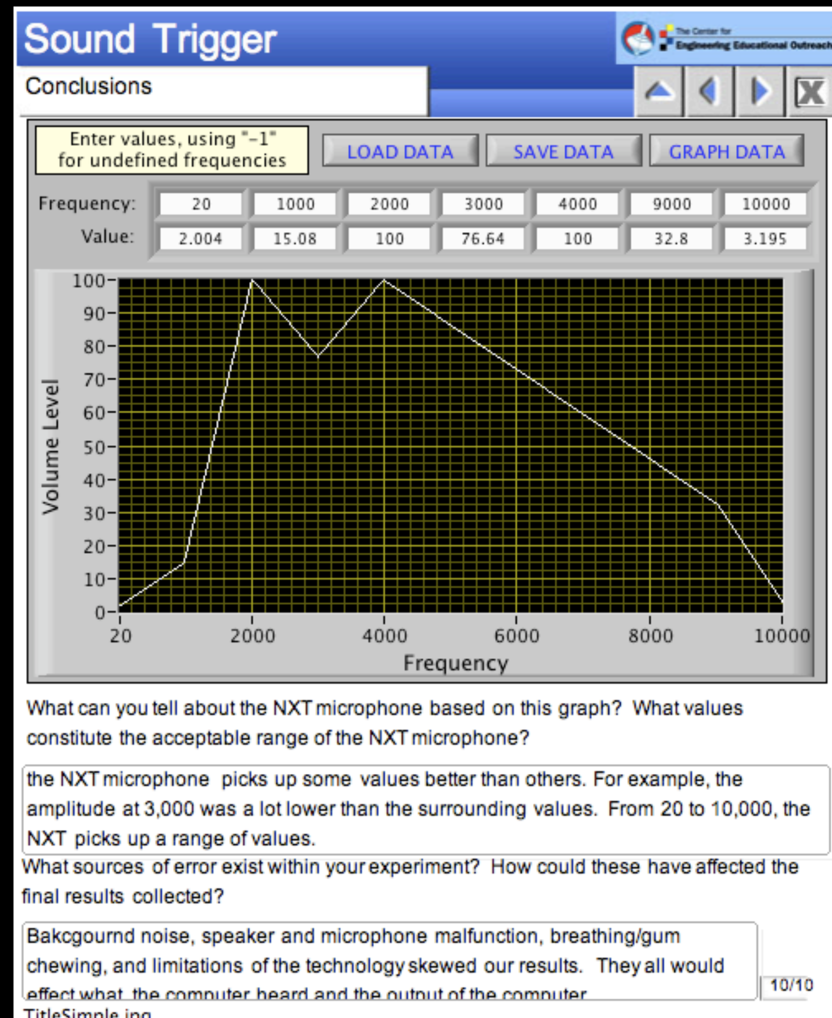
Describe below the final process on which everyone agreed you will be using. Then take some pictures of the final set-up once you have created it.

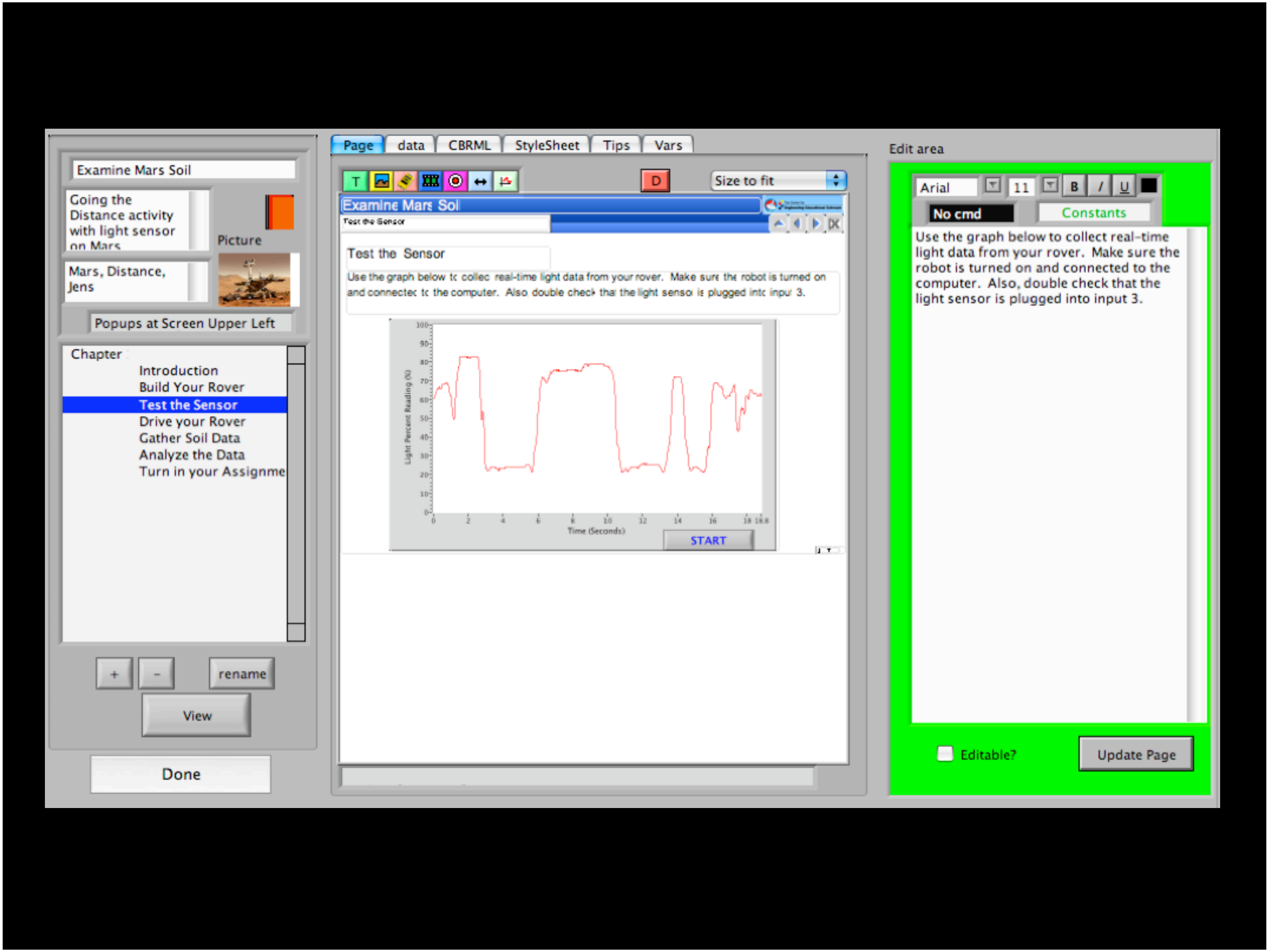
Our group tested the values of 16,000, 17,000, 18,000, 19,000 and 20,000 and recorded the average values. The class compared everyone's values and picked and tested those that didn't make sense. We tested the sounds at full volume on the computer and volume of 5 on the program.

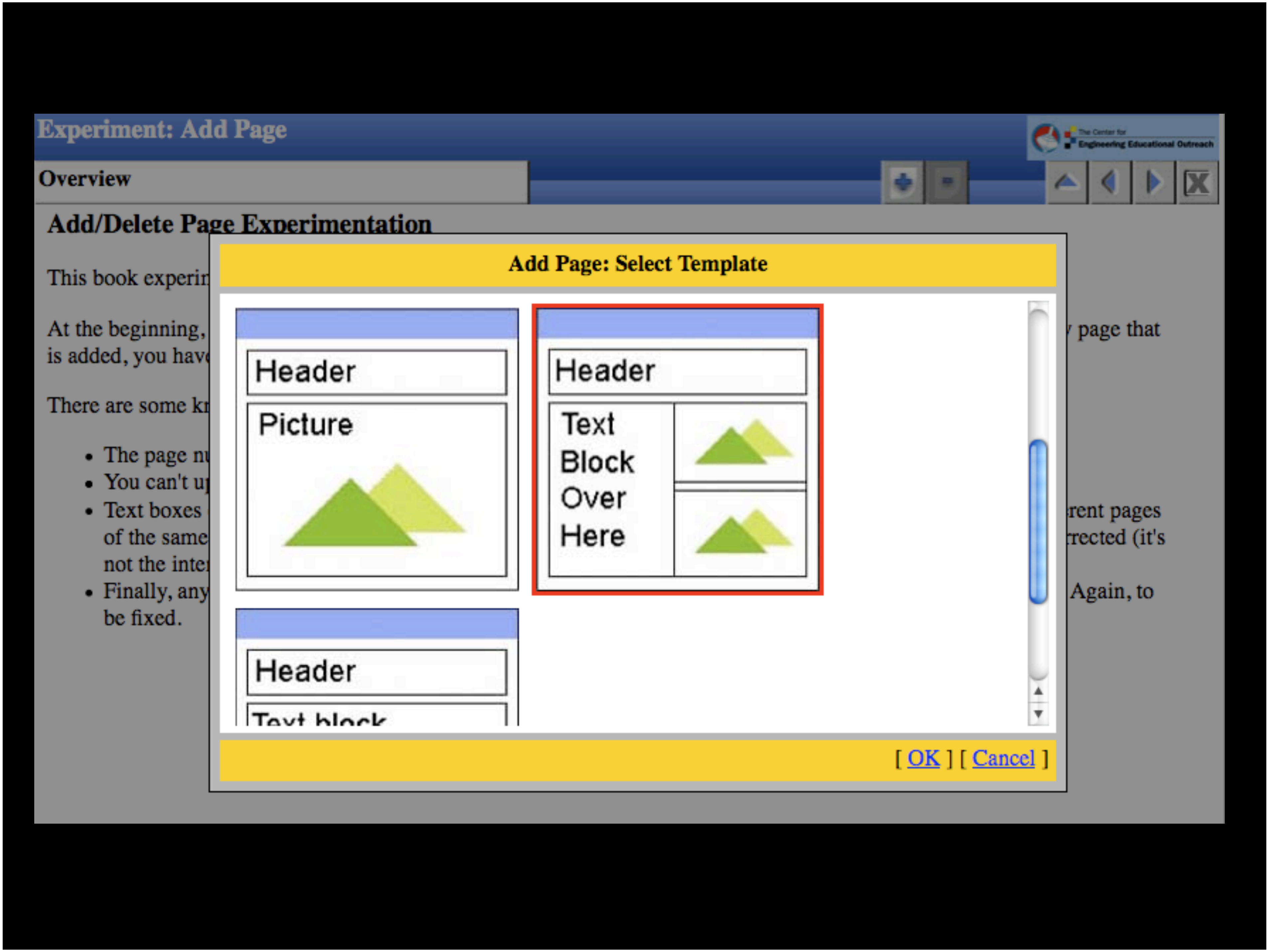


TitleSimple.jpg


Sound Trigger
Conclusions
Enter values, using "-1" for undefined frequencies
LOAD DATA
SAVE DATA
GRAPH DATA
Frequency: 220 440 880 1500 5000 7500 10000
Value: 0 0 0 0 0 0 0
Volume Level
Frequency
What can you tell about the NXT microphone based on this graph? What values constitute the acceptable range of the NXT microphone?
What sources of error exist within your experiment? How could these have affected the final results collected?
10/10
TitleSimple.jpg

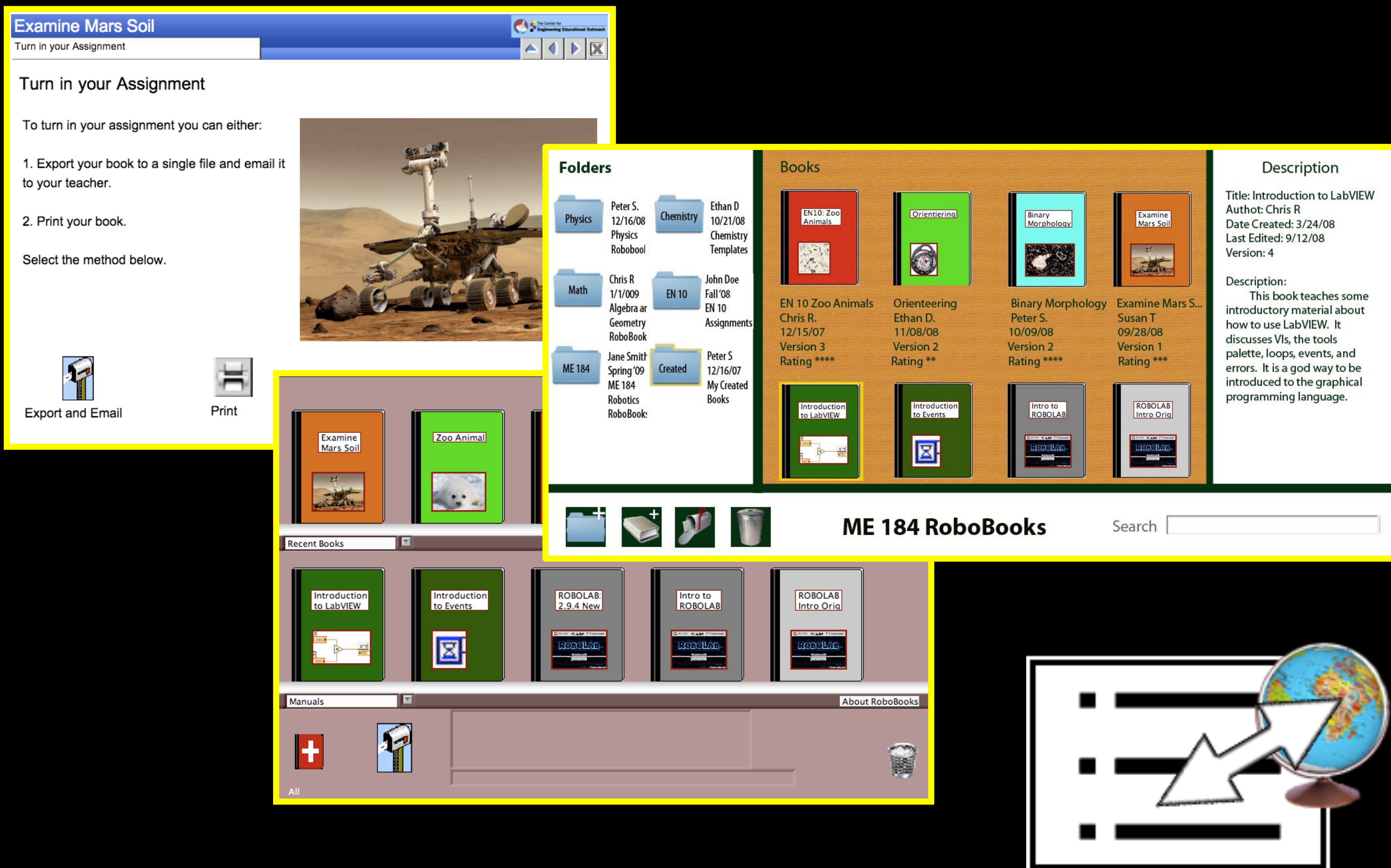

Sound Trigger
Conclusions
Enter values, using "-1" for undefined frequencies
LOAD DATA
SAVE DATA
GRAPH DATA
Frequency: 20 1000 2000 3000 4000 9000 10000
Value: 2.004 15.08 100 76.64 100 32.8 3.195
Volume Level
Frequency
What can you tell about the NXT microphone based on this graph? What values constitute the acceptable range of the NXT microphone?
the NXT microphone picks up some values better than others. For example, the amplitude at 3,000 was a lot lower than the surrounding values. From 20 to 10,000, the NXT picks up a range of values.
What sources of error exist within your experiment? How could these have affected the final results collected?
Bakcgournd noise, speaker and microphone malfunction, breathing/gum chewing, and limitations of the technology skewed our results. They all would effect what the computer heard and the output of the computer
10/10
TitleSimple.jpg


Examine Mars Soil
Going the Distance activity with light sensor on Mars
Picture
Mars, Distance, Jens
Popups at Screen Upper Left
Chapter
Introduction
Build Your Rover
Test the Sensor
Drive your Rover
Gather Soil Data
Analyze the Data
Turn in your Assignme
+
-
rename
View
Done
Page
data
CBRML
StyleSheet
Tips
Vars
D
Size to fit
Examine Mars Soil
Test the Sensor
Test the Sensor
Use the graph below to collect real-time light data from your rover. Make sure the robot is turned on and connected to the computer. Also double check that the light sensor is plugged into input 3.
Light Percent Reading (%)
Time (Seconds)
START
Edit area
Arial
11
B
I
U
No cmd
Constants
Use the graph below to collect real-time light data from your rover. Make sure the robot is turned on and connected to the computer. Also, double check that the light sensor is plugged into input 3.
Editable?
Update Page



Experiment: Add Page
Overview
Add/Delete Page Experimentation
This book experin
At the beginning,
is added, you have
page that
There are some kı
The page nı
You can't uj
Text boxes
of the same
not the inte
Finally, any
be fixed.
rent pages
rrected (it's
Again, to
Add Page: Select Template
Header
Picture
Header
Text
Block
Over
Here
Header
Text block
[OK] [Cancel]

Sharing via One Button Publishing



Thank You

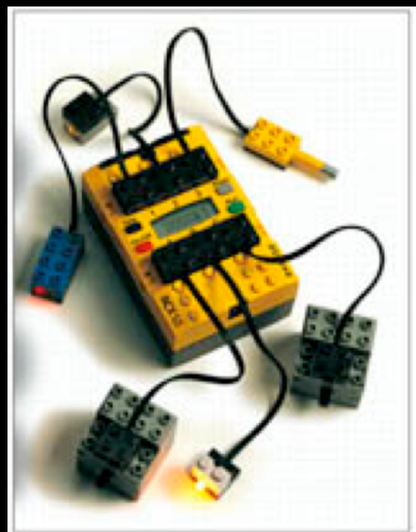
For more information about our Center or this project specifically, please contact:

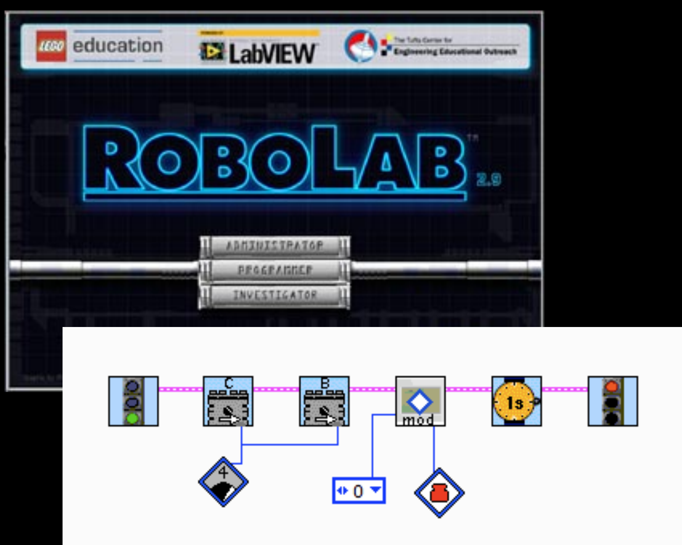
Dr. Chris Rogers – crogers@tufts.edu

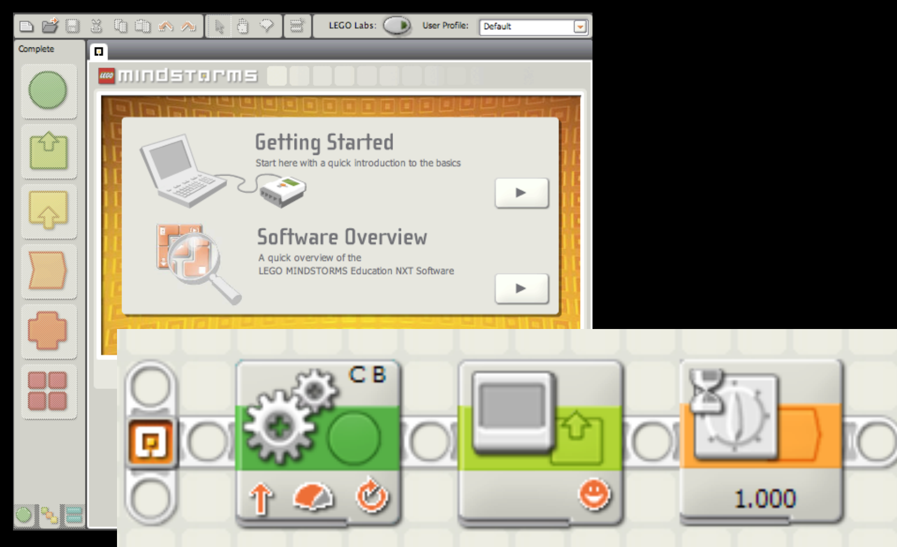
Dr. Ethan Danahy – ethan.danahy@tufts.edu

Supplemental Slides

The LEGO Robotics Platform








Examine Mars Soil
Zoo Animal
EN10: Zoo Animals
Orientiering
Loop the loop
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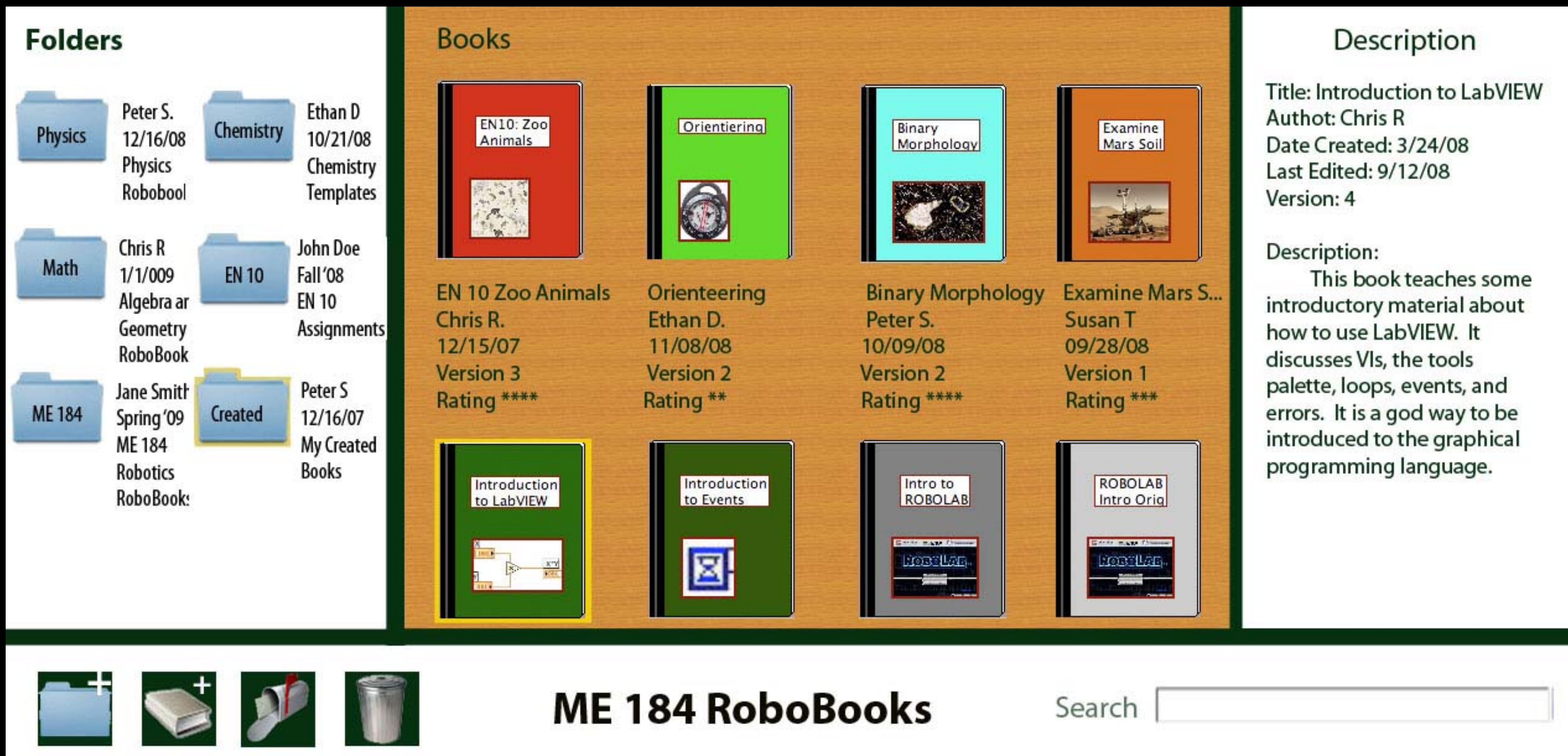
Folders
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Geometry
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John Doe
Fall '08
EN 10
Assignments
ME 184
Jane Smitl
Spring '09
ME 184
Robotics
RoboBook
Created
Peter S
12/16/07
My Created
Books
Books
EN10: Zoo Animals
EN 10 Zoo Animals
Chris R.
12/15/07
Version 3
Rating ****
Orientiering
Orienteering
Ethan D.
11/08/08
Version 2
Rating **
Binary Morphology
Binary Morphology
Peter S.
10/09/08
Version 2
Rating ****
Examine Mars Soil
Examine Mars S...
Susan T
09/28/08
Version 1
Rating ***
Introduction to LabVIEW
Introduction to Events
Intro to ROBOLAB
ROBOLAB Intro Orig
Description
Title: Introduction to LabVIEW
Authot: Chris R
Date Created: 3/24/08
Last Edited: 9/12/08
Version: 4
Description:
This book teaches some introductory material about how to use LabVIEW. It discusses VIs, the tools palette, loops, events, and errors. It is a god way to be introduced to the graphical programming language.
ME 184 RoboBooks
Search

Why This Works: Classroom Management

- Step 1 + Step 2 + Step 3 and "wait, what was Step 2???"
- Activity can troubleshoot itself
- Teachers more satisfied with curriculum
- Students more motivated and engaged

Why This Works: Increased Interactivity

- Between student and technology
- Between student and work
- Between student and student
- Between student and teacher
- Between teacher and teacher

Why This Works: Simple Customization

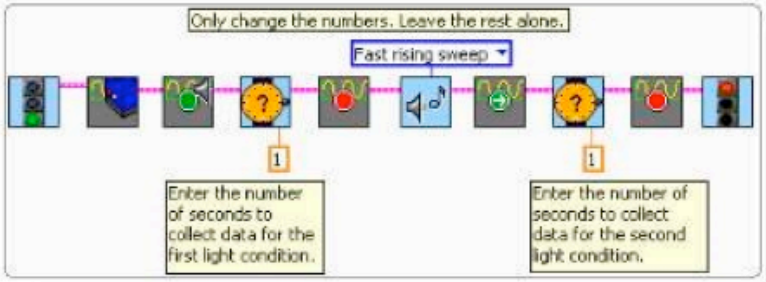
- Teachers easily customizing activities
  - Ability to change look/appearance and content based on personal preferences, classroom specifics, local standards, languages spoken, etc
- Student authoring activities themselves
  - Recording progress, generating reports, combining real-world/real time data with multimedia elements

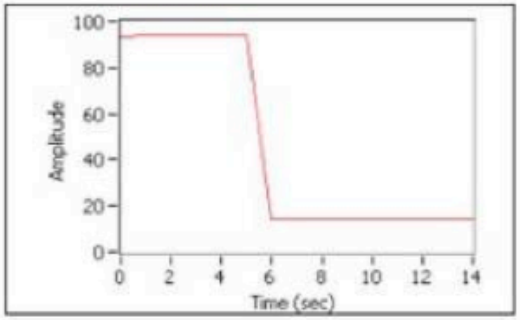
Light Sensor Task

Light Sensor Task

In this task, you are going to try out the light sensor with the LEGO NXT robot. You will specify how long the NXT will take light measurements and then try to duplicate the graph to the right with the sensor.

Attach the light sensor to your NXT in port 1. Then, upload a picture of your NXT by clicking on the picture to the left.



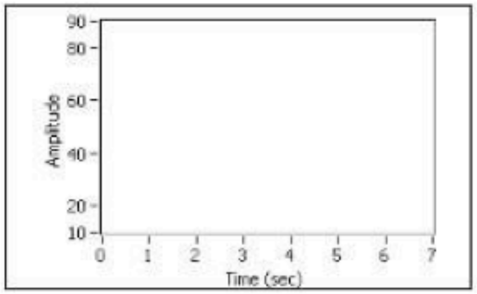


The code above will allow the NXT to collect data with the light sensor. Change the times the sensor is collecting data to match the graph to the right. The light sensor will click when it is collecting data and then beep to tell you to switch lighting conditions. Collect data and try to match the graph by clicking the arrow button and running the program on the NXT.

Now that you have collected data with your NXT, let's see if your graph matched the one above. Upload your data by clicking on the graph below and selecting Add Data.

Group Name:

Group Members:



lightgraph2.jpg

Examine Mars Soil

Analyze the Data

Analyze the Data

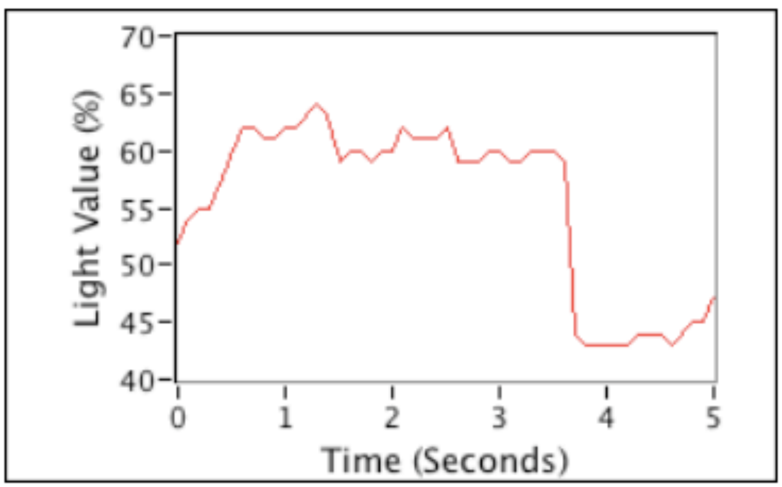
Based on the data you collected, find the **darkest** and **lightest** soil locations. At what time did the rover reach these spots? How far away from the start are those areas?

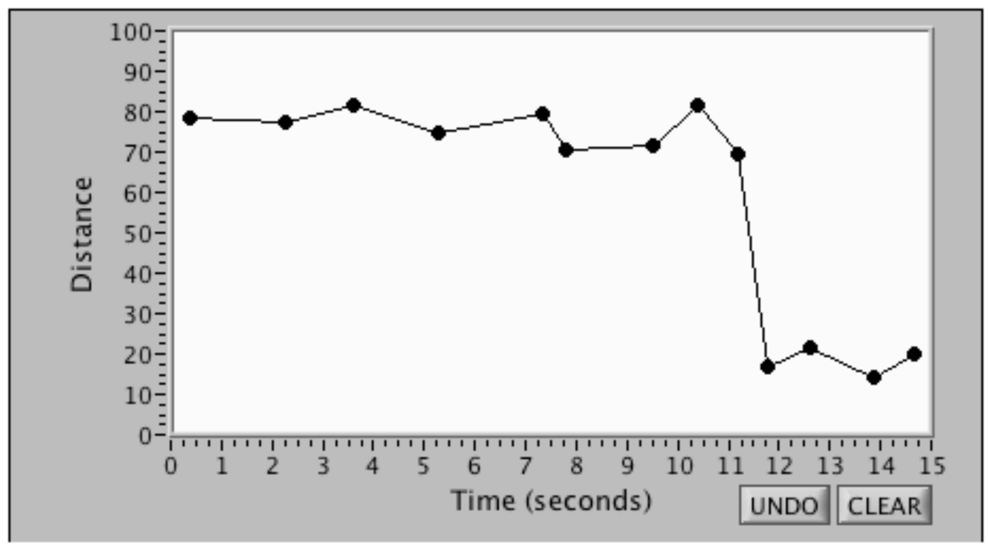
Darkest spot:

Time: Distance:

Lightest spot:

Time: Distance:





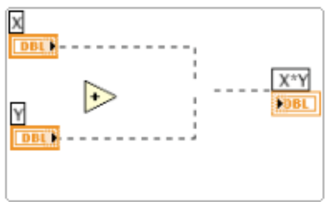
TitleSimple.jpg

Introduction to LabVIEW

Bad wires

Bad wires occur any time you have a wiring error and can be fixed by deleting the bad wire and rewiring the connection. You can either use the select tool and the delete key or "Remove Broken Wires" in the Edit menu. Try identifying the error in the program below and then fixing it.

In this case the error is due to the fact that the wires end in space, rather than in an icon. Try linking them to again or deleting and re-wiring.

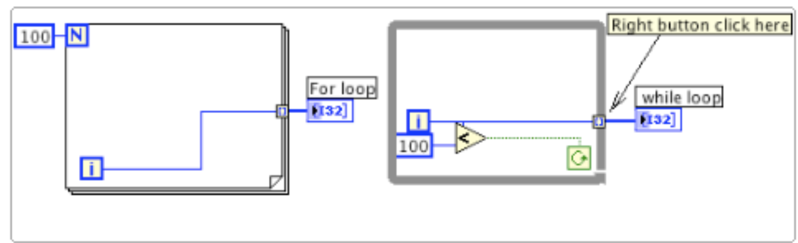


Introduction to LabVIEW

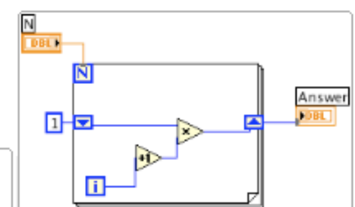
Loops and Structures

LabVIEW has many different structures you can use in a program. They include for loops, while loops, case statements and event structures and each one has a lot of different attributes so I will only give a general overview here. For more help, go to the web pages at the end of this book.

So the for loop and while loop below both generate (and plot) an array of 100 members. The left loop (for loop) automatically indexes the array, with each iteration of the loop adding a new element on to the array. The while loop, on the other hand, does not and you have to right button click where the wire crosses the while loop and select "Enable Indexing." Try modifying the code a little. First, change the number of points in each case to 500. Then try plotting the sin(i*pi/180).



Finally, try playing more with shift registers. Run the program to the right with the execution highlighting on (the light-bulb next to the Run button). What does the program do?



Type Your Answer Here