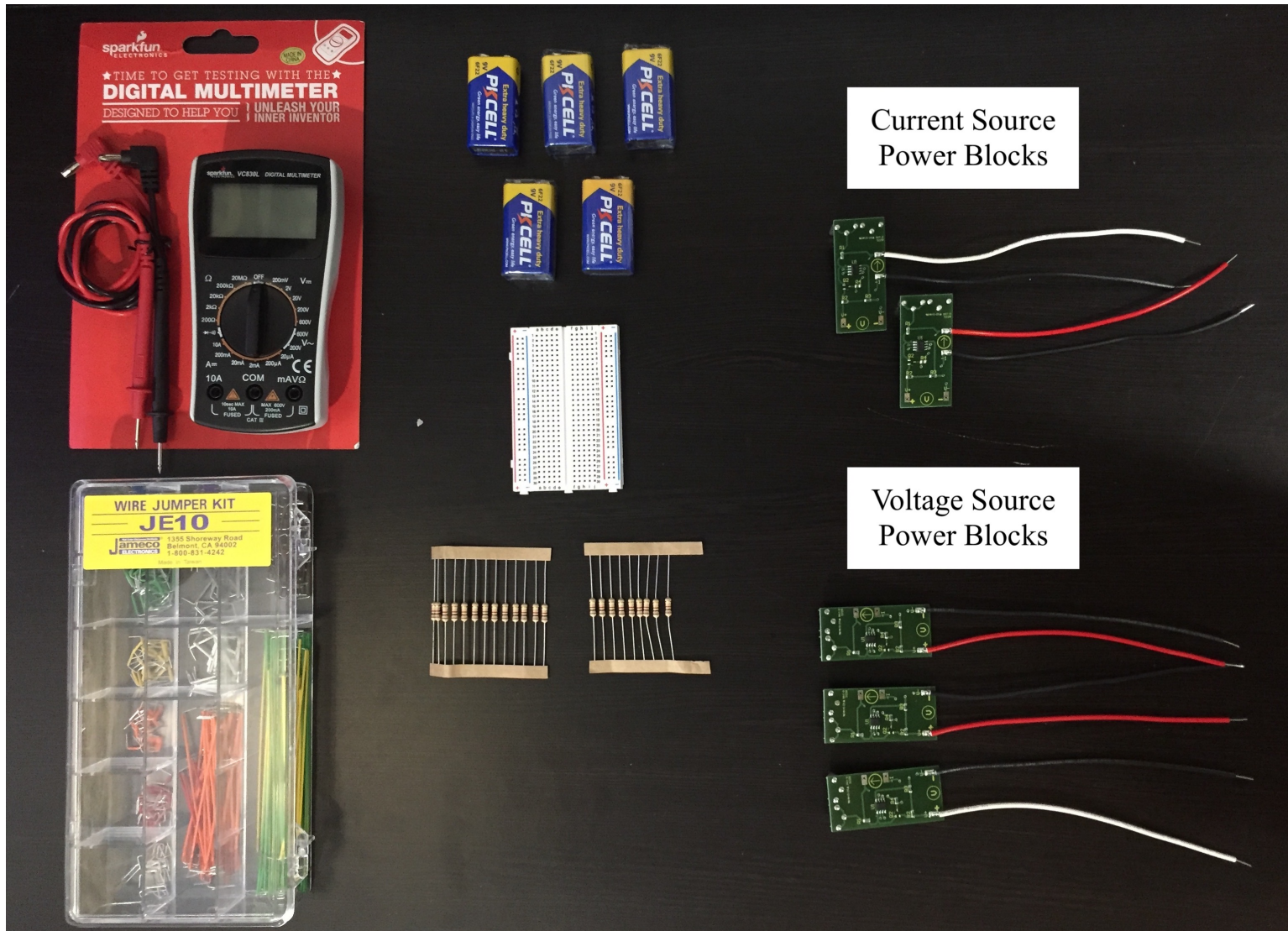


Power to the Students

Democratize discovery in STEM Classes

**Chris Sakurada
Hayden Seto
Jeffrey Anderson**

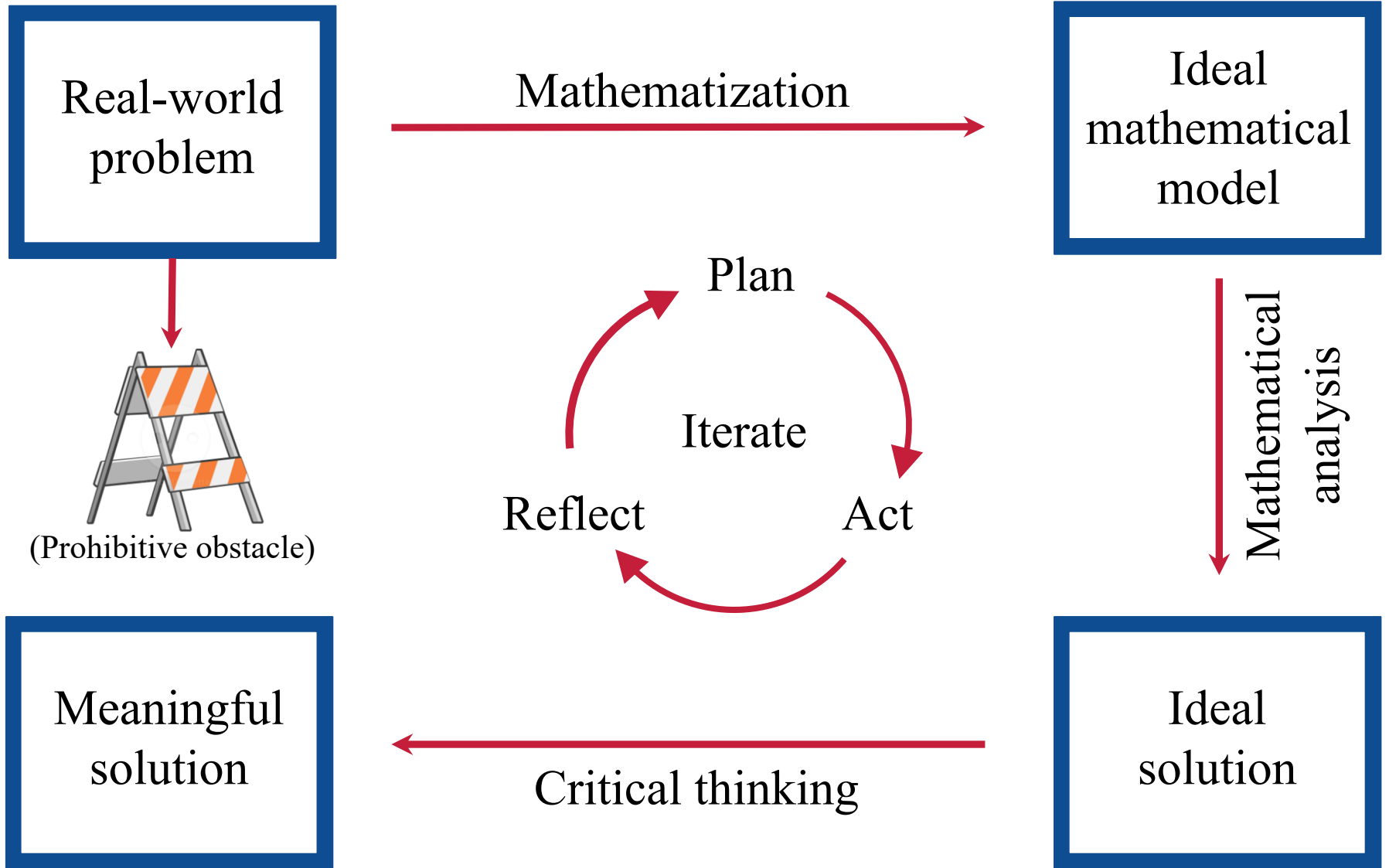
Electronics Learning Lab Kits



Current Source
Power Blocks

Voltage Source
Power Blocks

Applied Mathematical Modeling Process



P-Block Project Overview

Thank you to our master engineer: Mike Sasnett

Thank you Hayden Seto and Chris Sakurada

Thank you to Mike Sasnett, Jose Espina, and SunnyTech

Version 0



Version 1



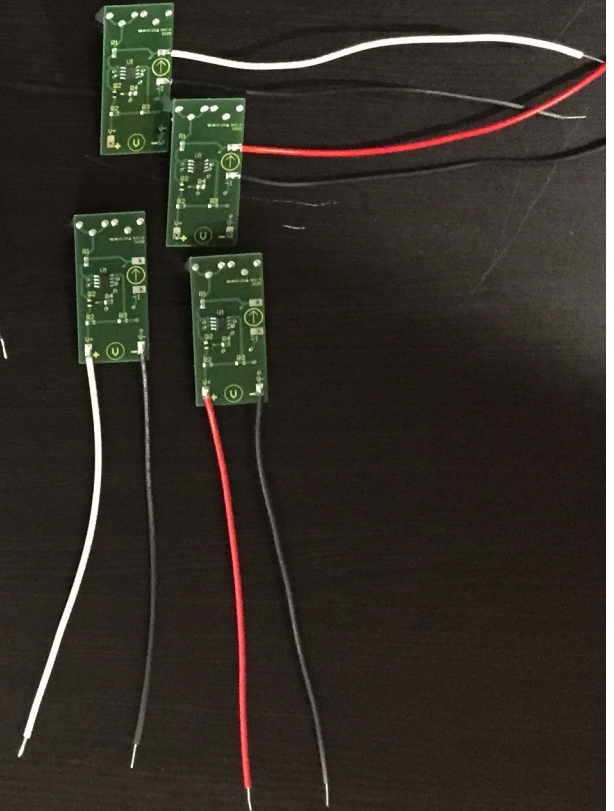
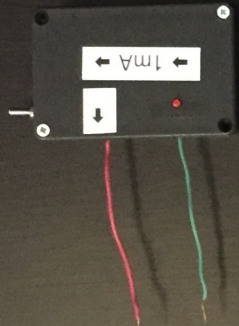
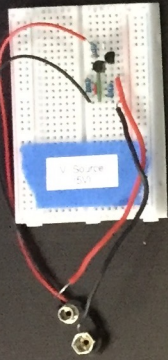
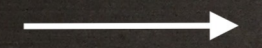
Version 2



Version 3



Version 4



Initial Design

Prototype

Materials

Schematic Capture

Milled Assembly

Board Layout

Manufacturing

PCB Assembly

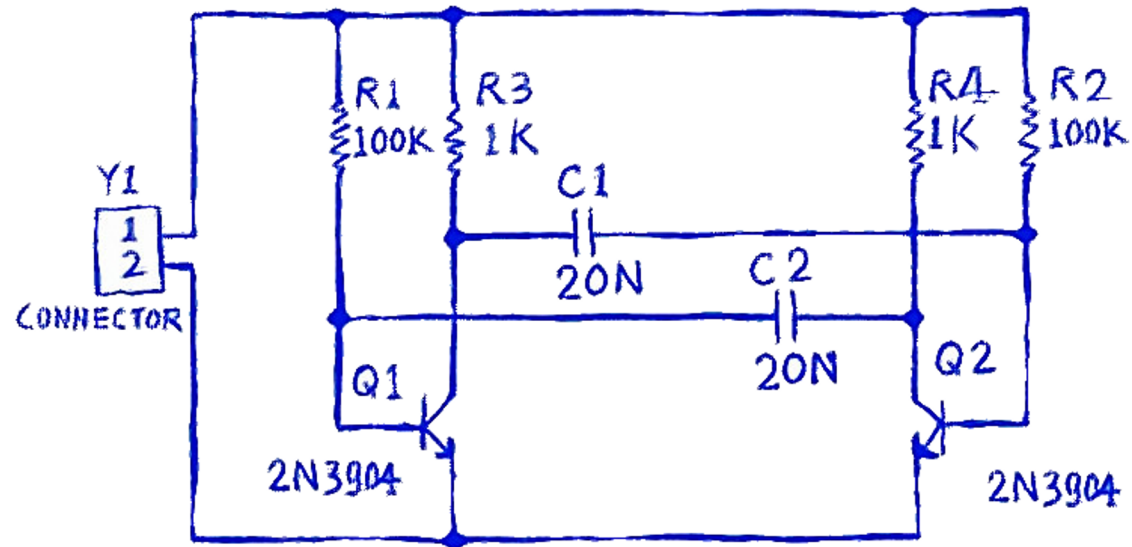
Packaging

Deployment

Improved Design

Impact

Initial Design



Source: <https://techdocs.altium.com/cn/display/ADOH/Tutorial+-+Getting+Started+with+PCB+Design>

Initial Design

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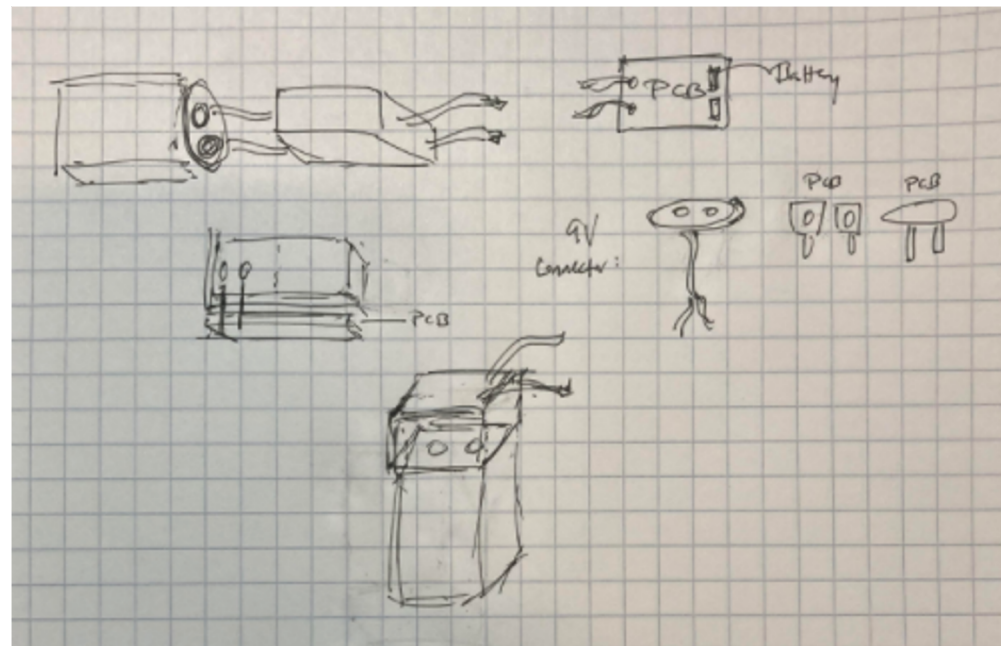
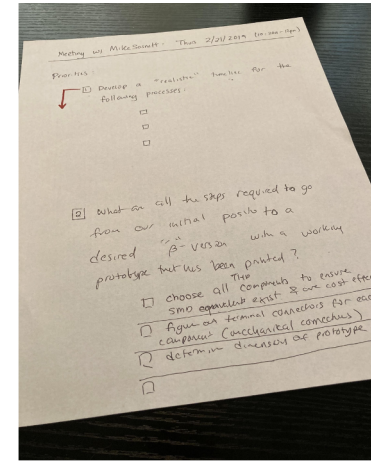
Deployment

Improved Design

Impact

Prototype

- Decide device requirements
 - Low cost
 - User friendly
 - As small as possible
- Brainstorm Ideas:



Initial Design

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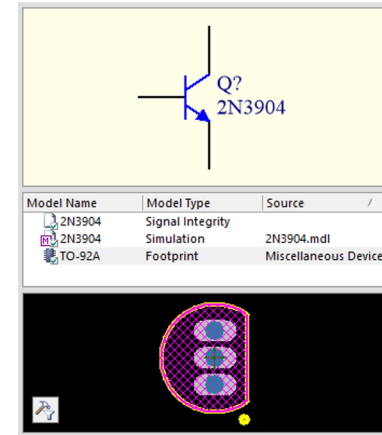
Deployment

Improved Design

Impact

Materials

- Component Selection:
 - Availability
 - Cost
 - Schematic Symbol
 - PCB Footprint



Components:	# of Units	Cost Per Unit	Total Component Cost:
Axial Resistor	150	0.02928	4.38
Axial Resistor	250	0.02144	5.36
Voltage Regulator	150	0.2859	30.89
NPN Transistor	150	0.0884	13.26
Keystone 9V	150	0.94339	141.5
Hammond Enclosure	150	0.58	87
Araldite 2011 epoxy	1	150	150
PCB	150 (75/75)		36
22 AWG Wire	3	14.3	43
		Total Cost:	511.39

Initial Design

Prototype

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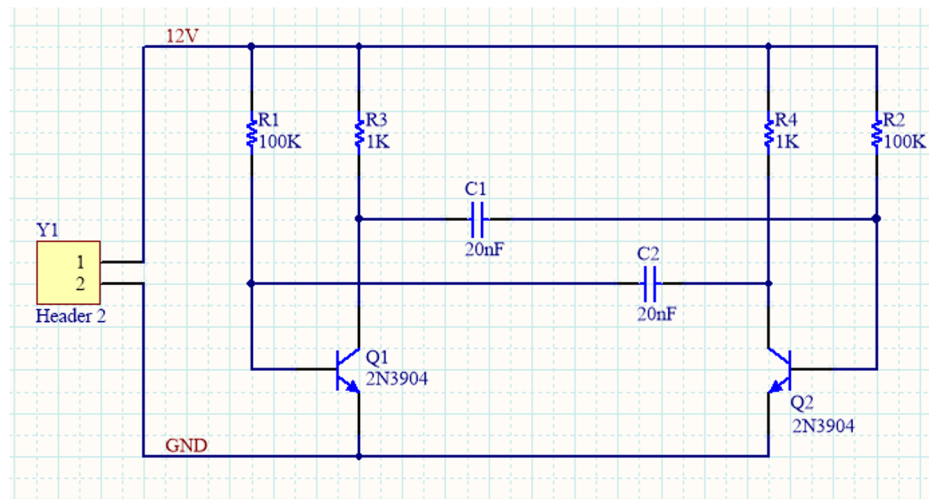
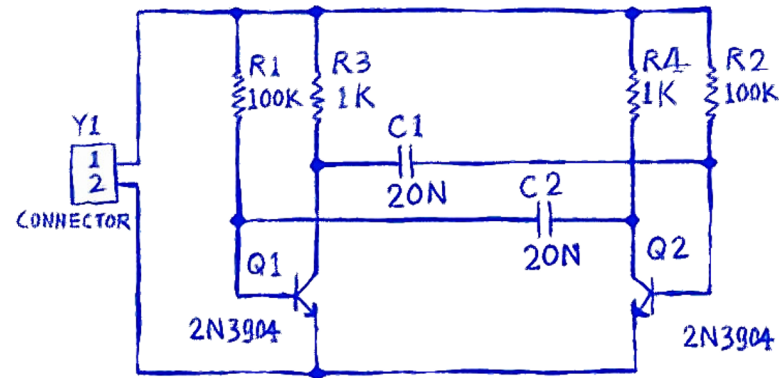
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Impact

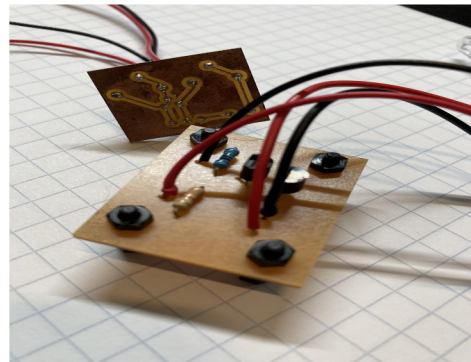
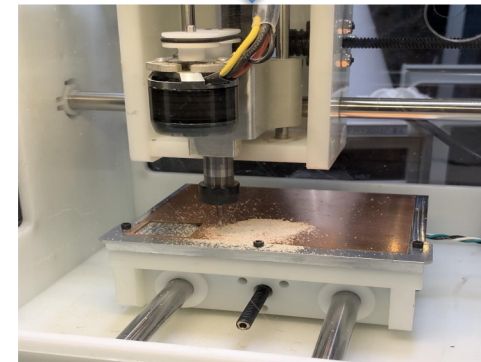
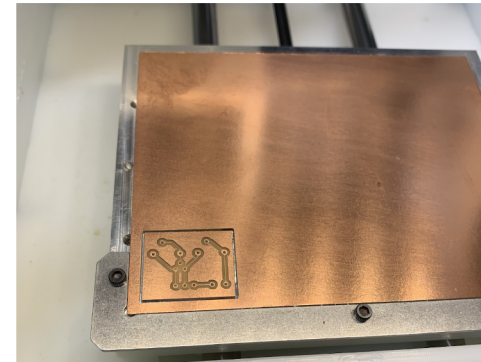
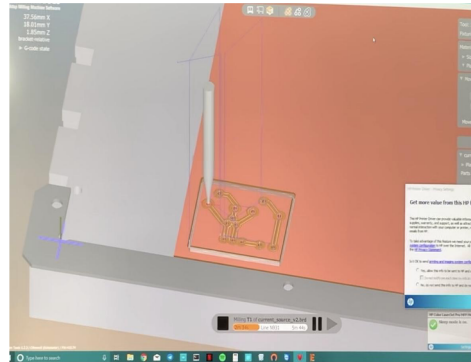
Schematic Capture



Initial Design
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Packaging
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Impact

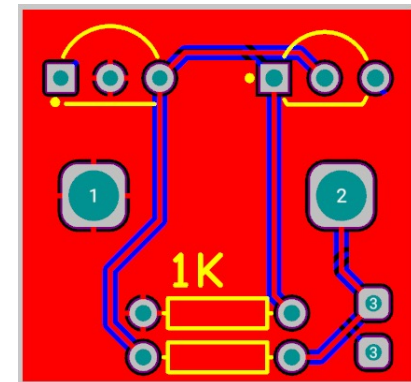
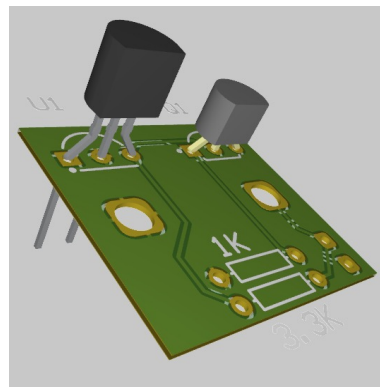
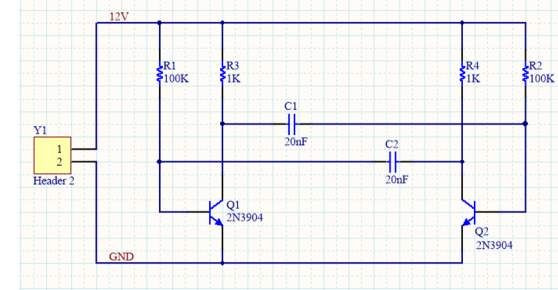
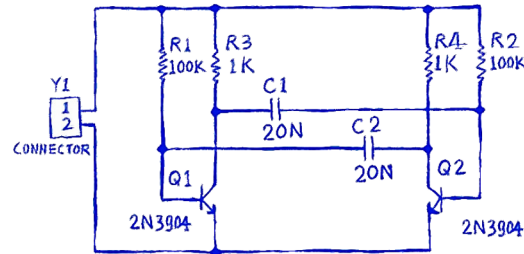
Milled Assembly

- Provides a physical sense of dimension and verify schematic capture is successful



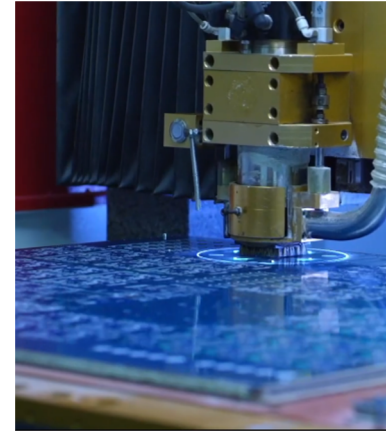
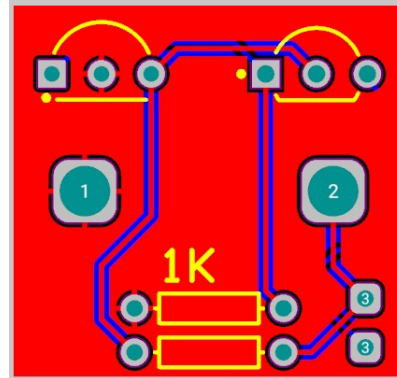
- Initial Design
- Prototype
- Materials
- Schematic Capture
- Milled Assembly
- Board Layout**
- Manufacturing
- PCB Assembly
- Packaging
- Deployment
- Improved Design
- Impact

Board Layout

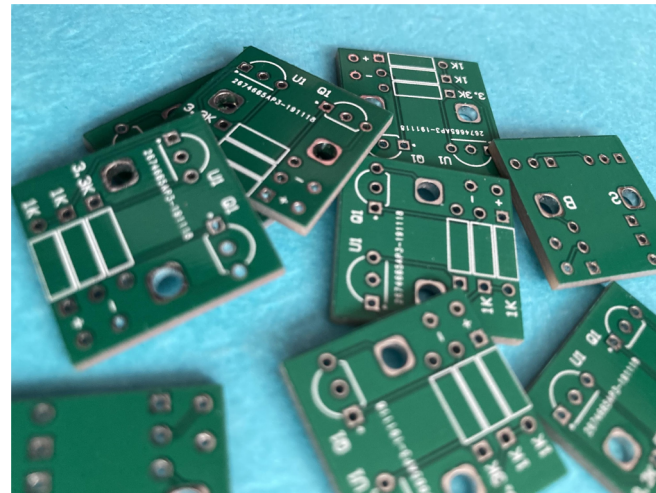


- Initial Design
- Prototype
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- Board Layout
- Manufacturing**
- PCB Assembly
- Packaging
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Manufacturing



Source: jlcpcb.com/aboutus



Initial Design

Prototype

Materials

Schematic Capture

Milled Assembly

Board Layout

Manufacturing

PCB Assembly

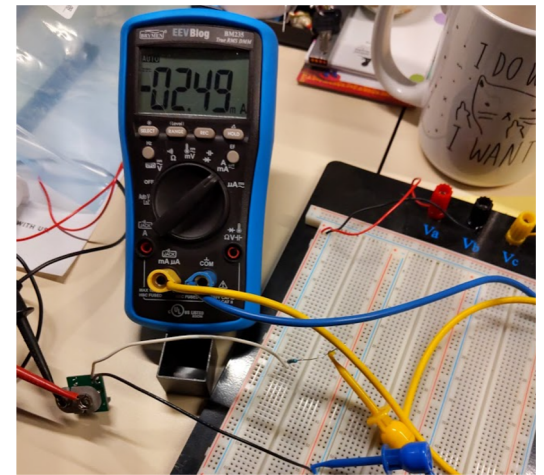
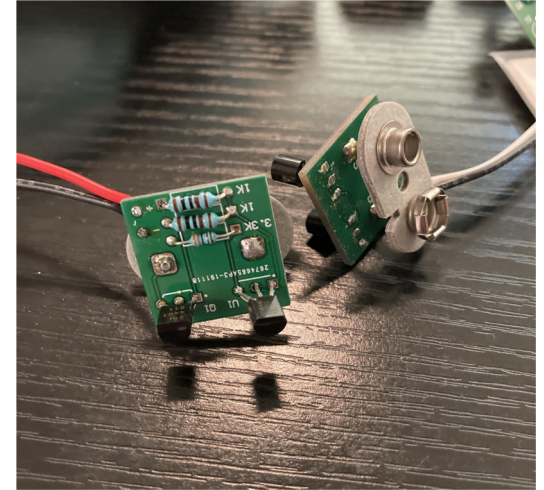
Packaging

Deployment

Improved Design

Impact

PCB Assembly



Initial Design

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PCB Assembly

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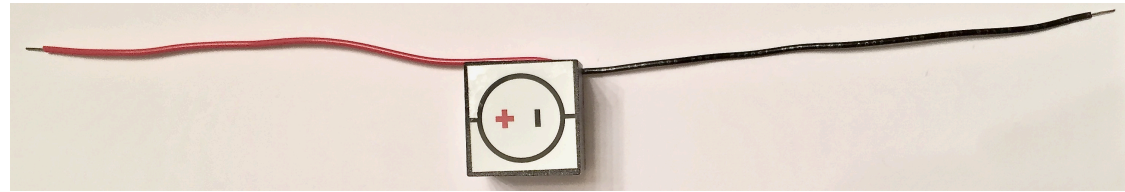
Improved Design

Impact

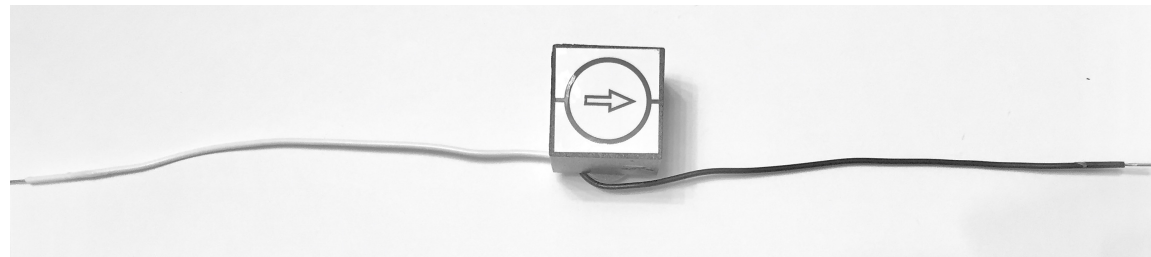
Deployment

P-Blocks are ready to use:

- Voltage Sources

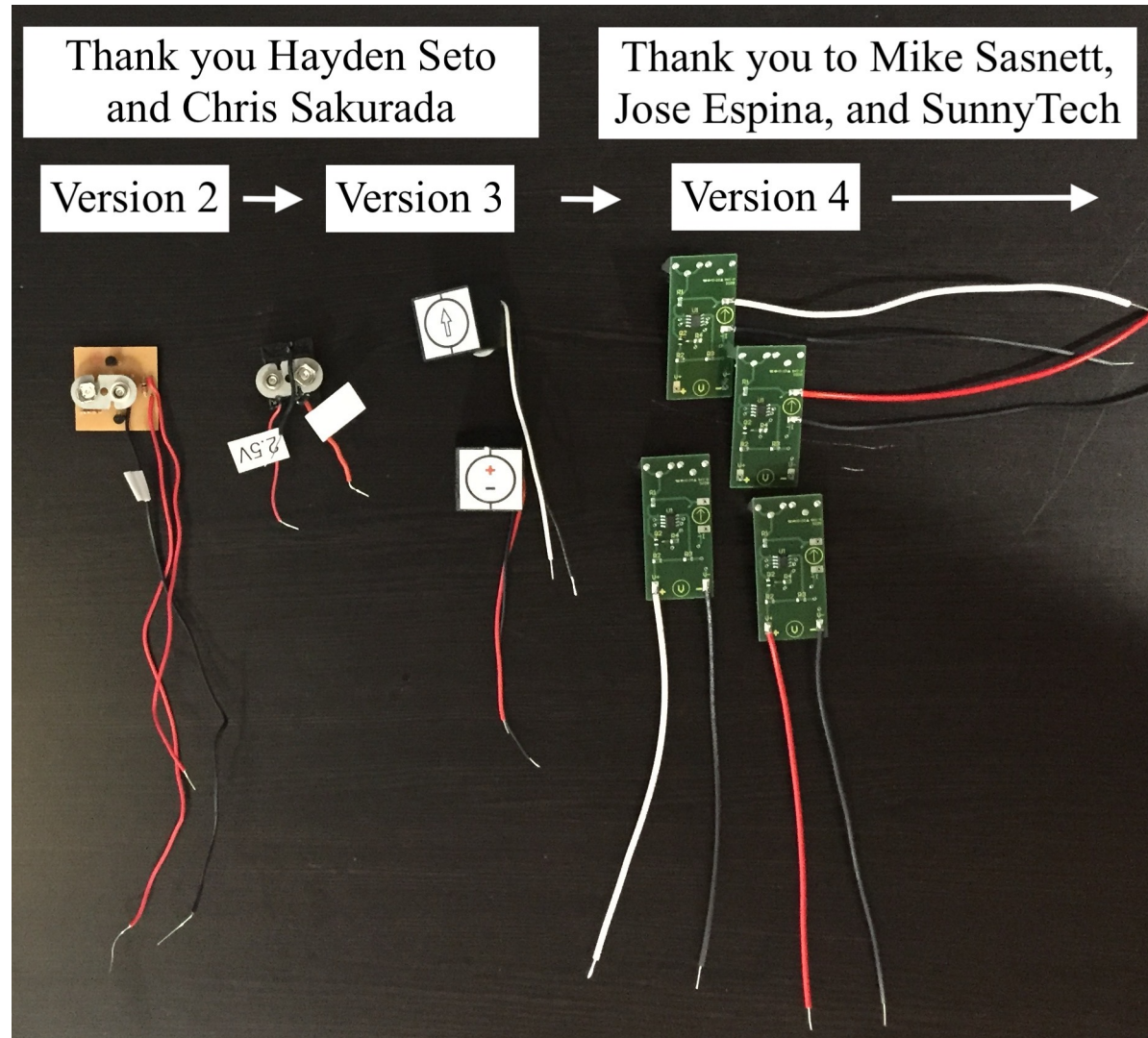


- Current Sources



- Initial Design
- Prototype
- Materials
- Schematic Capture
- Milled Assembly
- Board Layout
- Manufacturing
- PCB Assembly
- Packaging
- Deployment
- Improve Design**
- Impact

Improved Design

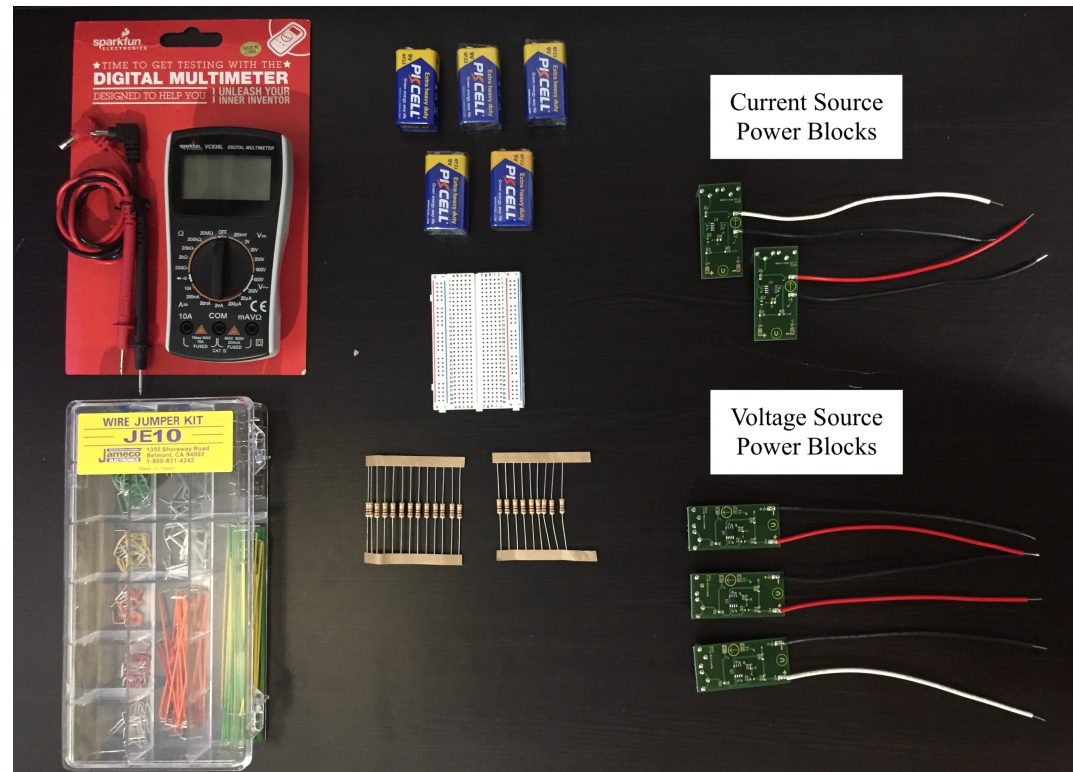


Initial Design
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Deployment
Improve Design
Impact

Improved Design

Electronics Lab Kit:

- 2 Voltage Sources
- 2 Current Sources
- Breadboard
- Multimeter
- Jumper Wires

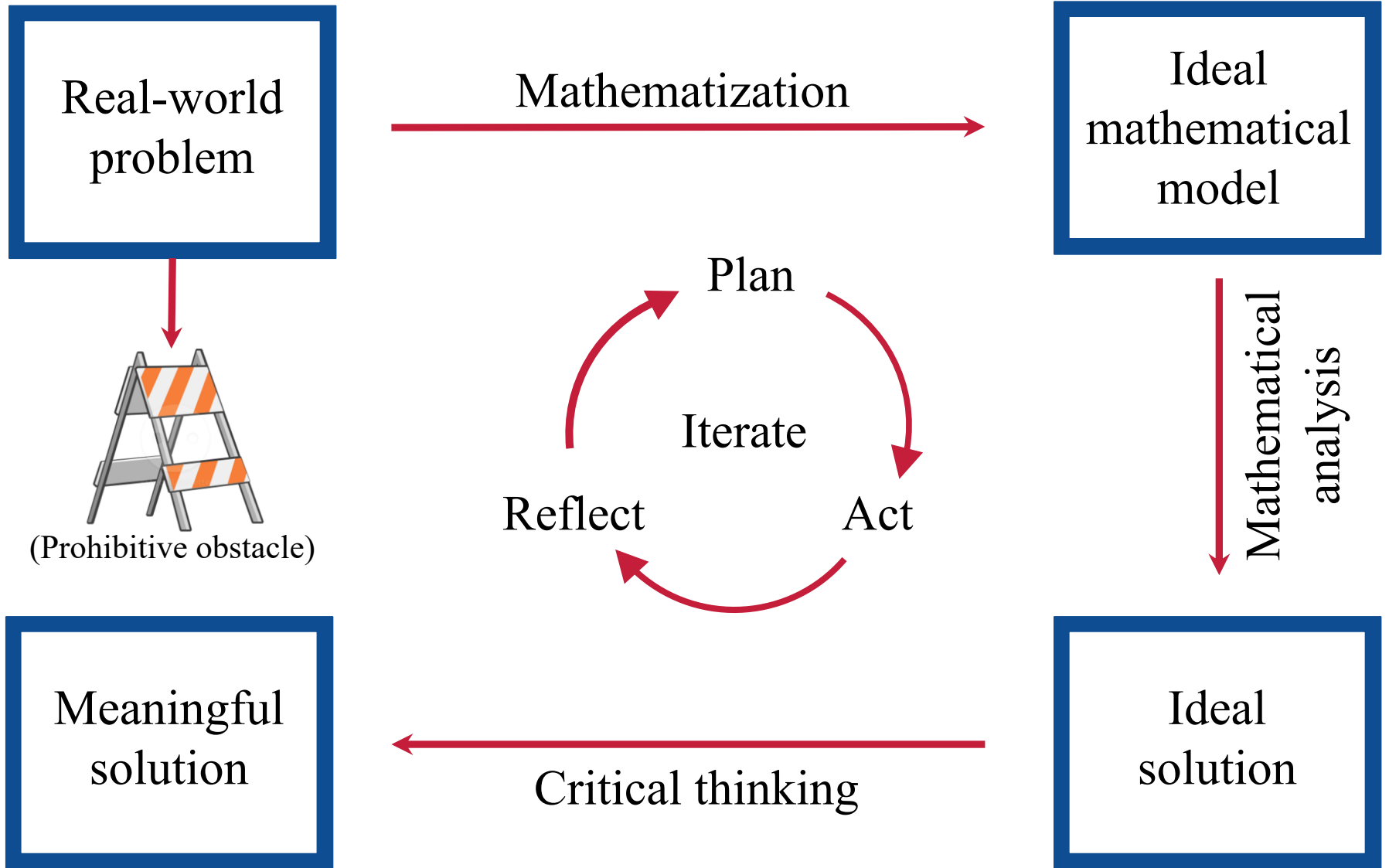


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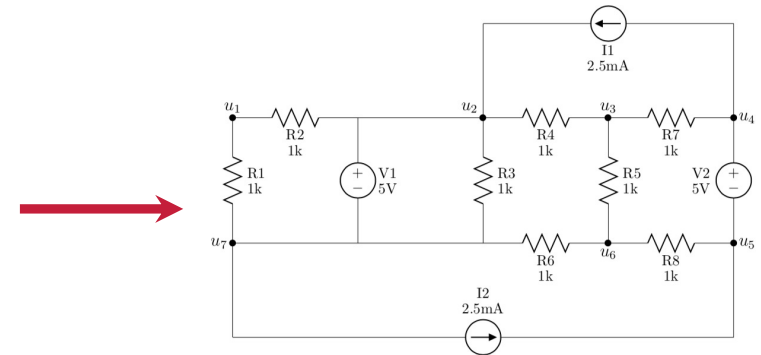
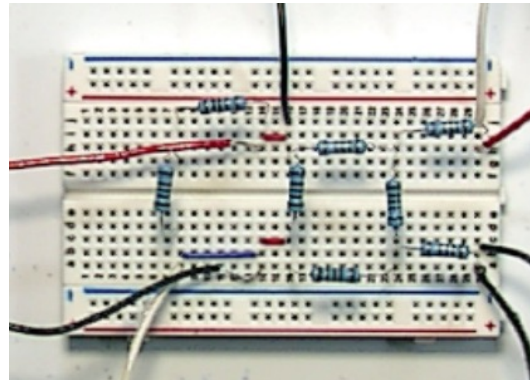
Class Title	Class Description	Quarter	# Students that used Lab Kits
Math 2B	Applied Linear Algebra	W21, S21	43
Engineering 11	Intro to MATLAB	W21	20
Engineering 37	Circuit Analysis	F20, S21	32
Physics 4B	Electricity and Magnetism	W21, S21	68
TOTAL:			163

Applied Mathematical Modeling Process



- Initial Design
- Prototype
- Materials
- Schematic Capture
- Milled Assembly
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- Improved Design
- Impact**

Impact



Node Variable	Measured value (V)	Modeled value (V)
u_1	2.497	2.50
u_2	4.98	5.00
u_3	3.728	3.75
u_4	4.95	5.00
u_5	0.003	0.00
u_6	1.241	1.25
u_7	0.000	0.00

Table III: Model verification

$$\begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 3 & -1 & -1 \\ 0 & -1 & 2 & -1 \\ 0 & -1 & -1 & 3 \end{bmatrix} \begin{bmatrix} u_1 \\ u_3 \\ u_4 \\ u_6 \end{bmatrix} = \begin{bmatrix} 5 \\ 5 \\ 5 \\ -5 \end{bmatrix}$$