RealSimPLE:

Pipes

The Tube - Assembly Instructions

RealSimPLE lives on the web:

For high school: in Swedish and English http://www.speech.kth.se/realsimple

For college and university, in English: http://ccrma.stanford.edu/realsimple

Questions about RealSimPLE can be e-mailed
to nelsonapollolee@gmail.com or to hellmer@kth.se .

RealSimPLE - Reality and Simulations in a Pedagogical Learning Environment – is a collaborative research and development project involving KTH, Stanford University and the House of Science. It is supported through the Wallenberg Global Learning Network. www.wgln.org by the Knut and Alice Wallenberg Foundation.

Kungliga Tekniska Högskolan; School of Computer Science and Communication; Department of Speech, Music and Hearing. www.speech.kth.se

Stanford University, California, USA - Department of Music, Center for Computer Research in Music and Acoustics (CCRMA). http://ccrma.stanford.edu

House of Science, KTH Albanova, www.houseofscience.se

Contents

Materials and Tools

The following meterials and tools are needed to build the experiment equipment.

Tools

Saw (preferably a jigsaw), soldering iron, wire cutter/stripper, a screw gun or power drill.

Materials

Materials and components:	Approximate price
1 x PVC plastic tube[1]	$3
1 x PVC plastic tube connector (optional)	$3
1 x Miniature loudspeaker[2]	$3-5
1 x Mini jack ∅3.5 mm, 3-pole	$3
1 x Mini jack ∅3.5 mm, 3-pole	$3
1 x Miniature microphone[3]	$3-5
1 x 10µF tantalum electrolytic capacitor	
1 x 2K2 resistor	
Insulated wire, two different colors (red and black are used in these instructions)	
Electrical tape	
or	
1 x Preassembled miniature microphone	$10
1 x flower stake	
Solder	
Approximate total sum:	$18-25

[1] The plastic tube used for electrical installations with the inner diameter 20 mm and the outer diameter 22 mm is recommended.

[2] Use a miniature loud speaker with good characteristics. We used a Fabr Veco Vansonic 20CL32G, try to find an equivalent to match the diameter of the tube.

Impedance:	32 Ω
Frequency range:	600-5500 Hz
Maximum output::	0.1 W
Efficiency:	74 dB (0.1 W at 0.5 m)
Dimensions:	∅ 20 mm x 3.6 mm

Notice that the diameter of the miniature loud speaker fits the PVC tube. The impedance of 32 Ω is well suited to the headphone output of a computer. The lower limit of the frequency range should be as low as possible.

[3] The miniature loud speaker should also have good characteristics. We used a Fabr Vansonic PVM6052, try to find an equivalent or identical microphone.

Impedance:	5.6 kΩ
Frequency range:	20-16 000 Hz
Input voltage:	1-10 VDC
Sensitivity:	12 mV/Pa
Dimensions:	∅ 6.0 x 5.2 mm

Assembly

The assembly of the loudspeaker, microphone and pipe should not take more than an hour or two. Twining the wires is necessary to reduce electrical interference and make them more manageable.

Twining the Wires

1. Cut two identically long pieces of red and black insulated wire, long enough to reach from the connectors on the sound card to the lab bench. These wires will be used to connect the miniature loudspeaker to the computer's soundcard.
2. Insert one end of each wire into the chuck of the drill or screw gun and tighten it softly.
3. Have another participant firmly grip the other end of the wire pair (or attach to a vise).
4. Stretch the cables carefully and slowly start twining the wires. 20-40 revolutions per meter wire, depending on wire thickness, should be sufficient.
5. Cut two more identically long pieces of red and black insulated wire, 2' longer than the prior pair, to allow for insertion into the tube. Repeat step 2-4 with this pair.

The Miniature Loudspeaker

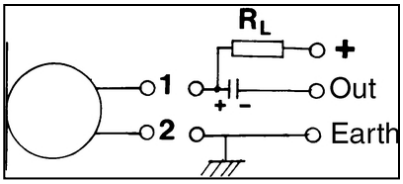
1. Strip approximately ¼" off of all four ends of the longer wire pair.
2. Unscrew the casing of the mini jack.

3. Solder the red wire to the centermost solder connection of the jack which corresponds to the tip of the connector.
4. Solder black wire to the longest solder connection which corresponds to the sleeve of the connector. (The remaining solder connection that corresponds to the ring of the connector is not used).
5. Slip the loose ends of the insulated wire pair through the mini jack's casing and reattach this to the mini jack.
6. Solder the loose ends of the wire pair to each of the solder pads on the miniature loud speaker.

The Miniature Microphone

If you have purchased a preassembled miniature microphone you can skip to *The Pipe*.

1. Cut two identically long pieces of red and black insulated wire, long enough to reach from the connectors on the sound card to the lab bench and 2' extra to allow for insertion into the tube.
2. Strip approximately ¼" off of all four ends of the wires.
3. Unscrew the casing of the mini jack.
4. Solder the black cable end to the longest solder connection on the mini jack which corresponds to the sleeve of the connector.
5. To ensure that both resistor and capacitor fits under the mini jack's casing their poles have to be shortened. First cut off most of the capacitor's negative cathode pole (the positive anode pole is usually marked with a line or being longer than the negative cathode pole), leaving just as much as is needed to solder it (less than ¼").



6. Solder the shortened pole of the capacitor to the centermost solder connection.
7. Shorten the capacitor's remaining positive anode pole and both ends of the resistor in the same manner as in step 5.
8. Solder one pole of the resistor to the second centermost solder connection (corresponds to the ring of the connector).
9. Solder the red wire to both of the free ends of the resistor and the capacitor.
10. Cover the solderings with electrical tape to avoid short circuit both between the solderings and to the casing.
11. Slip the loose ends of the wires through the mini jack's casing and reattach it to the mini jack. Be careful not to wreck the solderings.
12. Solder the other end of the twined wires to the miniature microphone; the red wire to its output terminal and the black wire to its ground terminal.

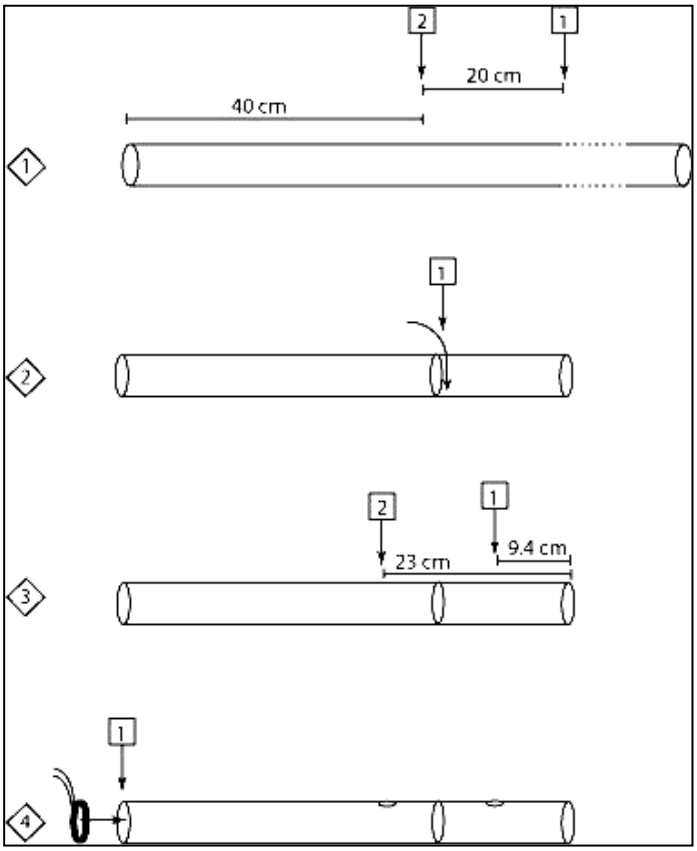
The Tube

1. Saw off two pieces, 20 cm and 40 cm long, from the PVC tube. Use a file to smoothen out ruggedness.

2. Use the plastic tube connector to connect the two pieces.

3. Drill the first hole 9.4 cm from the end of the shorter tube (position 1) and the second hole 23 cm from ditto (position 2). Use a conical file or the tip of a sharp knife to carefully remove ruggedness from the holes.

4. Attach the miniature loudspeaker to the end of the longer tube piece (position 1) using electrical tape. Also fix the wires with the tape to make the solderings more resistant to wear and tear during use.



Testing the Equipment

Test the miniature microphone by connecting its mini-jack to the microphone input on your computer soundcard (pink colored socket). Run the program *Windows Sound Recorder* which is found at `Start Menu -> Programs -> Accessories -> Entertainment`. Press the *Record* button (marked with a red circle) and very carefully touching the microphone capsule or making some noise. You should be able to see a graphical representation of the sound in the Windows Sound Recorder oscilloscope.

Test the miniature loudspeaker by connecting its mini-jack to the green line output (or headphone output if not available). Play back a sound file with music or noise using Windows Media Player which is also found at `Start Menu -> Programs -> Accessories -> Entertainment`. Of course you can use any other software that you are comfortable with for this task. If there are no sound files on your computer you can use the audio from the RealSimPLE CD. Insert the CD in the computer's CD-ROM and play back with Windows Media Player.

If there is no input from the microphone or if the loudspeaker is silent, verify that the settings in Sounds and Audio Devices Properties and Volume Control are correctly set. These can be found at `Start Menu -> Settings -> Control Panel` and `Start Menu -> Programs -> Accessories -> Entertainment.`

If the problem still persists it is likely hardware related. Check for short circuits in the mini jacks (might be from a soldered lug to the casing) and solderings on both the microphone capsule and the loudspeaker.

FAQ