HowToBuildAnEmbeddedAcousticInstrument

From ModernLutherie

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LapBox

Consider the design of the *LapBox*, which is an embedded acoustic instrument designed to sit in the lap of the performer:
After experimenting with *LapBoxes*, you will quickly gain practical insight into prototyping embedded acoustic instruments that sound good. The *LapBox* can be easily extended by adding custom sensors. Typically, this is done by mounting the sensors on the enclosure, wiring them to an Arduino, and connecting the Arduino to the internal Linux computer. Revision 2 of the design assumes that the sensors will be mounted on the top of the instrument. Revision 3 features the loudspeaker drivers on the front, allowing the sensors to be placed either on the top or on the ends, like the force-sensing resistors shown on the *LapBox* above.

**Process**

- First follow the instructions for building a powered loudspeaker *HowToBuildAPoweredLoudspeaker*. 

Then begin designing an embedded musical instrument using the techniques outlined on the Satellite CCRMA webpage (https://ccrma.stanford.edu/satellite). This will involve connecting some sensors to a Raspberry Pi via an Arduino board.

Then begin adding all of the components to the embedded acoustic instrument. **An acoustic test using a loud sinusoid to check for rattling should be used after adding each additional component.**

Finally, have fun performing with your instrument!

**Embedded Acoustic Instruments**

The complete electrical circuit is given below.
The components have been selected to make building the LapBox as simple as possible. In other words, the design should be accessible not only to engineers but also to artists. The circuit requires only a 12V power supply input. In practice, it was determined that a ground loop between the power supply and the audio connection from the Raspberry Pi to the audio amplifier could reduce the quality of the sound. Therefore, it is suggested to use an 1/8-inch (2.54mm) audio cable with inserted ground loop isolating transformer to break the potential ground loop.

Parts

The following parts are in addition to those required for building a powered loudspeaker. Several different loudspeaker drivers were tested. The driver part given below performed well given its size. It is recommended to use drivers with neodymium magnets as the final embedded acoustic instrument will weigh about 2 lbs (0.9kg) less. Wood glue is needed for assembly.

2 6-32 nylon screws to secure amplifier to instrument
2 6-32 nuts to secure amplifier to instrument
2 4-40 nylon screws to secure Raspberry Pi to instrument
2 4-40 nuts to secure Raspberry Pi to instrument
8 6-32 metal machine screws, nuts, and lockwashers for mounting drivers

Optional: Velcro to hold on back panel if air seal is desired

1 Raspberry Pi Model B (512MB)

1 Ground loop isolator with 1/8" (2.54mm) connectors at each end e.g. Kensington Noise Reducing Car Audio AUX Cable

1 12V to 5V USB power converter to power Raspberry Pi e.g. DROK DC Converter 12V to 5V 3A Car USB Charger

1 Optional: USB audio adapter to 1/8" (2.54mm) e.g. Logitech USB to 3.5mm jack stereo headset adapter


- This page was last modified on 28 April 2014, at 04:03.