HowToBuildAnEmbeddedAcousticInstrument

From ModernLutherie

Contents

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.

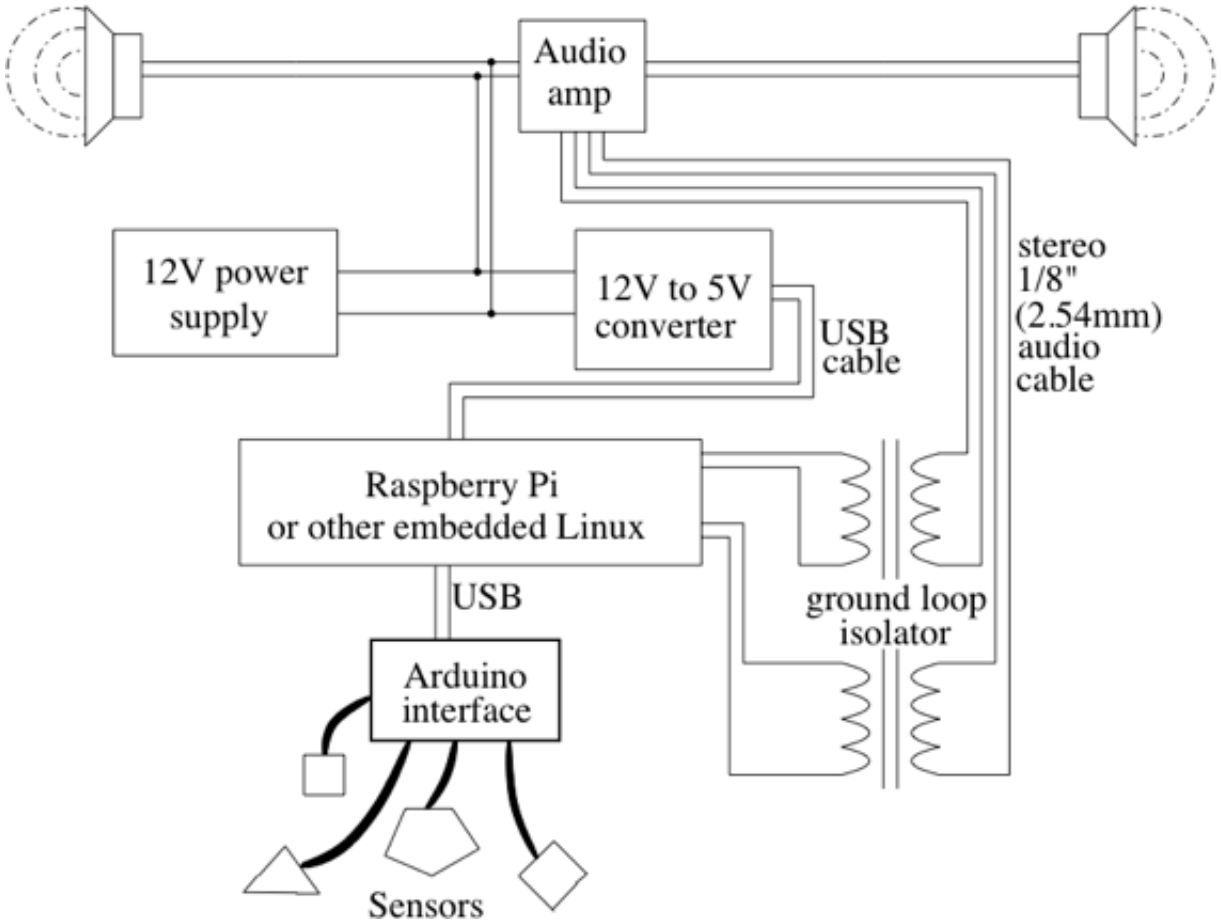
Process

- 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	6C150SPMN (http://www.olander.com)
2	6-32 nuts	to secure amplifier to instrument	6CHNTN (http://www.olander.com)
2	4-40 nylon screws	to secure Raspberry Pi to instrument	4C50SPMN (http://www.olander.com)
2	4-40 nuts	to secure Raspberry Pi to instrument	4CHNTN (http://www.olander.com)
8	6-32 metal machine screws, nuts, and lockwashers	for mounting drivers	Any hardware store
	Optional: Velcro	to hold on back panel if air seal is desired	Any hobby store
1	Raspberry Pi	Model B (512MB)	83-14421 (http://www.mcm.com)
1	Ground loop isolator with 1/8" (2.54mm) connectors at each end	e.g. Kensington Noise Reducing Car Audio AUX Cable	amazon.com (http://www.amazon.com)
1	12V to 5V USB power converter to power Raspberry Pi	e.g. DROK DC Converter 12V to 5V 3A Car USB Charger	amazon.com (http://www.amazon.com)
1	*Optional:* USB audio adapter to 1/8” (2.54mm)	e.g. Logitech USB to 3.5mm jack stereo headset adapter	amazon.com (http://www.amazon.com)

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