Questions on Kinetic/Electronic/Sensor Art Projects - Version 3.0

Andrew Anselmo
Clipboard Enginering
www.clipboardengineering.com
(To reach me; e-mail first name at this website)

In making kinetic art (art that has motion) or art that has any electronics or sensors embedded in it, there are a few questions you should ask yourself, and anyone who is helping you build your project. Feel free to send me additions to this list, and pass it on (with attribution).

1. **Better, cheaper, faster - pick only two!** You must figure out what is important to you; aesthetics, 'wow factor', reliability, etc. You can't have it all. What exactly it is you want to do? Remember that *quality is remembered long after the price is forgotten.* If you use cheap materials, connectors, and the like, things may break at the most inopportune times. Time and time again, in discussions with many colleagues, and on many projects, the small things, especially connectors, can be the downfall of many a system.
2. **Who will be building this?** You, or will you outsource it? Do you need to know how this works? Will you be "tweaking" it yourself?
3. **Who will maintain it?** Will this be in a gallery, where you have access to fix things? Will the people who will maintain it, turn it on and off, have any technical skills appropriate to the project?
4. **What is the size of the piece?** Can it be moved easily? Can you move it in parts? Are there any odd sized, sharp, or heavy elements? Are any elements delicate?
5. **When do you want it done?** Having a schedule is critical if you need help, or need parts.
6. **Where will this be set up?** Will this be a piece that is permanent, or temporary? For how long will it be in place? Do you need attachments to walls, the ceiling? Will it be shipped anywhere? Who will assemble it? If it is overseas, and you are using mains (AC) power, make sure you have the right AC connectors, and make sure your AC adapters can automatically handle 120 VAC and 240 VAC, or have the capability of changing input voltage. Some simple AC to DC converters are universal, and some are not!
7. **How will it be built?** Will this be glued together, or machined from solid aluminum? Will you be outsourcing this, or building all yourself? How much will this weigh, and how will you transport the piece?

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8. **What sort of environment will you be in?** Where will it live? In a covered atrium, outside all year-round, inside an office, or on a roof? Will it be exposed to the public in a way that will attract vandals, or people who will want to play with it? Are there any issues with temperature, humidity, wind? Near the ocean? What about local lighting? Can it (or will it) be solar powered? If so, how long can it operate without solar input?
9. **Will it be safe?** If you are using 120 VAC motors (standard household voltage), this may be an issue. Will there be any moving parts with pinch points? Will the piece be behind a shield, wall, or window? Will gallery staff be on hand to monitor people interacting with it? Will it produce loud noises, sparks, or high temperatures?
10. **How much noise can this make?** Will the sound of switches or relays be distracting from the piece? If you are using pneumatics, will an air pump be OK
11. **Think about how the public will interact with the piece.** If it is a truly interactive piece, you will need beta testers, and people who will attempt to 'break' your nice piece of art. Will kids or adults be interacting with it? If there are controls, they will need to be 'bulletproof' so that things can't be busted by overenthusiastic patrons.
12. **Aesthetics - how will the piece look?** Are there any critical dimensions, colors, or special details about the piece? Will the wiring be exposed? Can you even accept wires (wireless options are available for some sensors and the like)? Will the controls/wires be part of the aesthetic? If so, you should see what these pieces will look like. Otherwise, you will have to cover up or hide the mechanical parts. Note that most electronics need some sort of cooling, if any heavy currents are handled.
13. **Can you power the piece?** With regard to the location of the piece, check to see if there is enough power (if AC powered). If it is to go overseas, check that you have the right cabling and power connectors. Also note that having correctly grounded outlets (for AC systems) is critical for safety.
14. **Details on the guts of the piece** - If you are using electronics make sure you have a wiring diagram, or at least a system diagram and a hardcopy of the instructions nearby the piece, or attached to it. The use of exotic, extremely cheap, or extremely unique parts may cause problems if you need to fix things in the field. Design with the ability for it to be disassembled and debugged in the field. For this reason, things like the Arduino, although simple, may be better than more exotic setups. Make sure contact info (email, phone number) is on the piece.
15. **Special considerations** - Will the piece require vision, a constant flow of water, human presence detection, heating, cooling, special effects, lasers?
16. **Spare parts** – Supply chains are getting wonkier; make sure whatever you use can be fixed or replaced. Designing things with generic interfaces can help in this regard. A standard serial port, or sensor that uses I2C or SPI can generally be replaced by a substitute part. Likewise, you may wish to standardize on motor controllers, motors, and the like, just as you would standardize on nuts and bolts (preferably metric, if you are taking this overseas).
17. **Ease of assembly** – You may want to break down the piece into component parts for transport. Using common connector types is good, but you may wish to use

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polarized connectors (so you can't reverse power or signals). Likewise, you might build a system with the same family of connectors, but use 3, 4 and 5 pin connectors to differentiate between different elements, even if only three pins are used for a particular connector.

18. **More on documentation and debugging** – Having a manual on a piece of art may seem silly, but having one in both electronic and paper form can be incredibly helpful, for both yourself and anyone else who works on the project. Taking lots of pictures, and putting even an overall document on how the system works, and the source of the parts can be very helpful after the system has been built. Another consideration is debugging the system, and providing a way for you or someone else to check the status of bits, analog inputs, or other elements of the system. This can be done with small screens, LEDs, small speakers giving tones, etc. You may want a USB data stick with all details (and a tag on the USB stick) with all the elements for the piece attached to it. If your Dropbox, or other cloud storage is unavailable in the middle of nowhere, someone will have something to work with.
19. **Futureproofing** – When writing code or putting sensors in a piece, think about what might happen if you changed or upgraded to a different sensor or actuator. For example, if you go from an analog temperature sensor to a digital one, it can be helpful to have a single function or subroutine to get the temperature value. This makes maintaining and debugging things a bit easier.

Sources for materials and components

Locally in the Boston Area:

Microcenter – https://www.microcenter.com/ ; Cambridge, MA - they have plenty of Adafruit and Sparkfun components; also available online.

Radio Shack – https://www.radioshack.com/ ; The classic electronics parts store; their selection has been made smaller, but they still have things you may need. Also available on line.

You-Do-It – http://you-do-it.com/ ; Needham, MA – They have a wider selection of electronics components; more akin to Radio Shack.

MIT Flea Meet – http://w1mx.mit.edu/flea-at-mit/ ; Cambridge, MA - Every 'teenth' of the month (from April to October); the first Sunday after the day with the 'teen' in it. Lots of random electronics, and surplus gear. Go to their website to get a coupon for reduced price entry.

Online

Adafruit – adafruit.com ; A classic. Many tutorials. Note that if things are out of stock, you can also order them from Digikey and other places, such as Amazon. Amazon will

carry their parts, but at a higher cost. For sensors, you may want to look at Digikey, which will have some parts at cheaper prices.

Sparkfun – sparkfun.com – Like Adafruit.

Pololu – Pololu.com – Like Adafruit and Sparkfun; more emphasis on robotics.

Sainsmart Industries – sainsmart.com - Lots of sensors here, and CNC stuff.

Digikey – Digikey.com – Electronics parts.
Mouser – Mouser.com – Electronics parts.
Allied Electronics – AlliedElec.com – Electronics parts.

Beware of getting cheap parts from Amazon (through China) or Ebay. The parts may work, but it may be difficult in getting the exact same elements if you need more. Clones of various drivers, boards, and sensors maybe available very cheaply, but you may pay a price later.

More industrial elements and hardware

Automation Direct – https://www.automationdirect.com/adc/home/home ; Great for heavier duty switches, relays, and other industrial components, as well as pre-built enclosures for pushbuttons and switches that are more bulletproof.

McMaster – https://www.mcmaster.com ; A well organized and easy to search site for other elements for your art projects.

Grainger – https://www.grainger.com ; Another source for elements, like McMaster; also, they have local stores for pickup.

MSC – https://www.mscdirect.com ; Another source for parts.

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