Coil Winding Machines

One of the first machines we need to build in the Project is the coil winding machine. There will need to be many versions of this, as both size and number of units scale both up and down. What will the first coil winding machine look like? It should have a working directional bias, in the sense that unlike many of the motors I've built it must only push one direction, and reverse the direction if it starts wrong. I think a typical motor of the sort used for this will be 250 turns per coil, with 4 coils, or 1000 turns to make it even. I want not more than about 3 minutes to be the time to make that motor. So that's about 300 RPM(revolutions per minute). Divide 300 by 60 and we get 5 turns per second. Suppose we want to be able to pull 1 pound of force out at 2 cm of radius from the center. The speed at radius r is r2pi*f. Google lets you put in mixed units like this so putting in "1 pound force*5 Hz2pi*2 cm" gives about three watts. So I want a motor that can do about 3 W of actual work. So for 1.5 A and 5 V circuits this should be possible. A motor with a +/- X and +/- Y pair of coils and a large magnet of the proper shape should do this easily. Each pair of coils should sum to the resistance of about right to get an amp and a half. I imagine, as above, each coil about 250 turns, with 4 coils total, making two connected pairs, which can be driven by a single board, the version 6 of the coil control boards.

I also want a turn counter that is intuitive, with a nice display and reset. Also there should be a tool to measure wire gauge. And also a simple way to test for insulation failures. There also must be a system for easily mounting various types of wire source, based on typical coil configurations in sources like transformers, alternates, fan motors, etc. A mechanism needs to be invented to automate the process of setting the holder wires below the coil, then wrapping them up and around the torus after it's done spinning, and pulling the finished coil off, then coating the whole thing in some protective insulator. When all these things are automated, a single cell of the machine should be producing a fully finished set of 4 coils every 4 minutes or so. So a machine with N cells might be making a finished motor every 1/N of that. For 100 units, which seems feasible in a squat-factory pretty easily–producing 1500 in an hour! Clearly the limits to scale there quickly become finding feedstock fast enough, and how quickly that feedstock can be put into the automation system.

That choke point in the process leads to the task after making the coil winder: finding a mass-efficient way to get the right kind of junk and breaking it down. For the first, what is needed is to build up an economy that engages more humans to help forage the country side for the parts. For the second, this might well be the first of the robot rumbles: destructor robots. A destructor robot at its simplest is just a cutting tool that uses Philosophy Engine motors to drive the cutters. At its most complex, it references all found parts to a giant database of capitalist products, figures out where useful stuff is, prioritizes what to go after, selects tools, and uses them to break down source artifacts into higher quality feedstock.

One can imagine this working on a medium scale very easily. Imagine a crew of up to a couple dozen local people are trained in a focused hunt on top of their existing scavenging(scrapers and dumpster divers). They bring in wheelbarrow loads of, for example, alternators and fan motors. A person with various bionic extensions in the form of "prosthetic" limbs with cutting tools, able to run many tools at once with limited automation, is in a intake bay ripping through things and sorting them, and putting them into standardized pre-coil-pods. These can then get passed to someone else in the Value Circle economy outside the factory if someone wants to. Or they get passed over to the spinner room where many coil winders can run at a time, making coils. These coils have a spime type aspect where all the data of each coil is in/on the coil in a way that references back to an open database. So again, this becomes a commodity that can get passed along to more global value circles if someone wants to. An assembly robot is then just a set of motors that move everything into place to go from coils to a full motor(at least the stator part). Note that I forgot about the magnets and bearings. Both of those can also come from car and computer parts. Probably the simplest thing to do is a design based on a Samarium Cobalt magnet in a hard drive, then just give specs on desired drives.

So far what I've described has a lot of missing pieces. One of the largest is the same problem mining always has: what to do with the leftover material after the part you want comes out? In the short term this has to mean having the materials get re-absorbed into the scavenger ecosystem. I.e. if someone wants to drop off some raw alternators they need to pick up some alternator skins to return to wherever the rest of their junk goes. Ideally the research lab lives at this point of the supply chain circle: a major ongoing topic of research in the tribe will be studying how to make another part of the automation infrastructure with standardized parts that are shed by the main process. And eventually the scavenging process will be more based on controlling whole rumbles of robots so that that is more fun and less work and more productive. One type of robot might soar like a hawk on thermal drafts, scouting for miles around for areas to concentrate on, with large rumbles able to cover potentially unlimited area. Another type might get flushed down toilets, look for stuff in the sewer, then climb out and crawl home with various molecular treasures. Another robot will produce a huge number of itself and spend 200,000 years crawling across a plutonium sacrifice zone separating the various metals and collecting them for future use at the end of the radioactive decay. The goal to use human feedback, good user interface design etc. to make it possible with very limited automation to have small group of people control a very large set of large rumbles of robots.

All that's getting a bit ahead, however. First I have to make ONE coil winding machine, and make ONE more just like it out of an alternator from a junk yard and a couple magnets from old hard drives, then complete the loop. Then the robot revolution can start to scale. But it all starts with that one self-reproducing(with a little help) coil. It looks like the VERY next step is to upgrade the control boards to the version 6 design that allows for both plus and minus current through either coil, and replaces the two DIP socket op amps with a single dual channel SMT op amp chip. Once I have these, and have made them in house, I can optimize the motor that winds the coils, make a jig with sticks and wires to automate the process, then self reproduce with clean wire off eBay first. And then probably buy a couple more ebay things to test first before going for the full supply chain. With that motor in hand it makes sense to build all the demos, create a show out of them, make a simple capacitive storage system, a simple tablet robotic control with the Pi, and then write the book and look for funding.

3 Forms of Motion

The motor has three main types of motion I want to target: linear oscillation, rotation, and circular oscillation. Linear oscillation is the simplest, and I already have that working great. Rotation is what I've been mostly working on recently, and I hope to make a lot of progress on that this week. The third motion, which I'm calling circular oscillation, is the most unusual. The idea is to have a oscillator with two degrees of freedom(both of the other forms of motion have one), and to drive both with a preferred direction, clockwise or counter-clockwise. Suppose I have two harmonic oscillators, one driven with sine(blue) and one with cosine(green). Those are graphed here vs. time for an angular frequency of 1 rad/s:

Now is where it gets interesting. We now plot y vs. x instead of each vs. time here:

A circle! But of course we know this about sine and cosine: they are the coordinates of a circle, and the sign of the angular frequency determines the direction along which the trajectory is followed: CCW is positive frequencies and CW is negative. For the same trajectory as above, I now plot the angle vs. time(mod pi):

Note the positive slope. I think this thing is very useful and is not quite like anything in wide use in modern technology. The first application I'm excited about for this is pumps. In this case it might be two oscillators right next to each other with identical resonant frequencies, which change the volume of adjacent chambers in a fluid system. by changing the sign of the angular frequency and driving one at resonance with feedback and the other at a pi/2 phase shift, it should be possible to make a reversible pump with no bearings or blades or valves! I want that for so many reasons! A pump that can be easily built from found materials and has minimal moving parts and is reversible could be used for:

- irrigation
- hydroponics
- low failure rate bilge pumps and sump pumps for emergencies
- scaled way down and fabricated in PDMS or the like could be used for microfluidic circuits for many biotech applications
- vacuum pumps could be used for creating practical gas discharge tubes for many applications(DIY x ray machine = bad idea, right?!)
- hydraulic circuits for heavy equipment and any number of hydraulic machines
- same for pneumatic machines
- a air mattress pump that does not fill me with rage
- closed cycle pumps for dilution refrigerators
- various applications for remote pumping that require anti-fouling of some kind(chunks of crap can go through and it's ok).
- a quiet drive for aquatic robots and boats
- various air conditioners and refrigerators using various coolants, including water with a vacuum pump to make ice

But there's another even more insane application I'm excited about: hopping for locomotion. If a set of spring loaded legs on a robot are bounced in a circular motion with some CW or CCW orientation it should be possible to have a robot hop with a controlled direction and very fast and smooth resonant hopping motion. I'm pretty sure most animals that have a good hop like Kangaroos and rabbits have something like this going on, and store a bunch of potential energy in the springy leg of the animal. With some auto balancing I think it should be possible to make a one legged hopping robot. I also think this technology will be relevant for the propulsion of the ball robot: by shaking with the right orientation I think it should be possible to control the rolling and leaping very fast with fast feedback. That can also be used for various other linear drives that are not for propulsion as such, moving various linear things around for manufacturing for example.

But then there is another idea based on that which I'm kicking around which will probably go nowhere: having a figure 8 trajectory where one oscillator has a natural frequency of exactly 2x the other one. In this case the time domain looks like this:

and the plot of this trajectory in terms of x and y comes out like this:

I didn't draw the direction on here but you can trace it with your eye or finger, just pick a direction and go. The thing to notice here is that both of the lobes will have the SAME direction of motion. What this immediately makes me think of is the same kind of hopping motion as for the circular system but inside some kind of tube or pipe or channel. I have no idea if that can work, but what if it does?! It would be an awesome way to make fast sewer robots that can dive into tunnels and do things. Maybe that is a horrible idea. But I have a lot of horrible ideas.

Against Gears

Today I'm going to rant about gears: I'm against them.

The gear is one of the first and most common symbols we see of engineering and technology. It's used commonly as a generic logo by every kind of engineer and is generally seen as a point of pride by engineers. I, like others with a lot of time in advanced technical education, have felt the swell of pride on seeing a nicely drawn logo with a gear on it for some school or project that I'm involved in. It makes me feel powerful, and like I'm part of something great.

And indeed gears are great! What they can do is absolutely fascinating to study, mesmerizing to watch, and useful in just about every industry. One of my many favorite exhibits at the Exploratorium in San Francisco is one where a motor turns a shaft at one end of a huge number of pairs of gears which decrease speed from the drive motor so that you have centuries of time for one revolution by the time you get to the last gear! It's amazing to see how this precise mechanical thing that appears so simple can bridge this span of time from fractions of a second out to centuries. And I'm again and again amazed at what gear designers can do in terms of inventing new stuff. My grandfather was an engineer at Chrysler many decades ago, and was always at the cutting edge of calculator and computer use back in the old days to do computation for new gear designs. That work had very real impact on the quality of car that could be built.

Conversely the enemies of industrial society have always used the gear as a symbol of that which they seek to overthrow. The monkey wrench is generally thought to be a wrench thrown into the gears of "the machine", presumably not just breaking everything but making it very hard to repair. When Mario Savio spoke for the Free Speech Movement on the steps of Sproul Hall he said this:

"There's a time when the operation of the machine becomes so odious, makes you so sick at heart, that you can't take part! You can't even passively take part! And you've got to put your bodies upon the gears and upon the wheels…upon the levers, upon all the apparatus, and you've got to make it stop! And you've got to indicate to the people who run it, to the people who own it, that unless you're free, the machine will be prevented from working at all! "

What he was talking about 100% about the operation of a university(UC Berkeley). Universities presumably don't actually run on giant gears. But that metaphor still appears front and center: the thing he seeks to stop is not an office or stack of papers or some other University project, it's GEARS.

One other point I want to bring up about gears is steam punk. I love steam punk, I think it's really fun. I had a steam punk wedding! But it's important to remember what it's all about. At it's heart it's about recreating aspects of Victorian England and mixing them with the modern. And it's worth remembering that Victorian England is nothing to be nostalgic about. During the rule of Queen Victoria the British Empire was one of the most ruthless wielders of global economic and military power in history. In an empire where the sun literally never set, a small corporate elite in London(and a few other global imperial cities) exploited people throughout the globe as well as right next door in their hideous filthy shit hole of a city(literally, with actual holes filed with shit). These are people who felt the best way to regulate the opium trade in Singapore was to auction the monopoly off to the highest bidder then protect that monopoly with force. Not nice guys. So is all this just a coincidence? Did human technology just happen to be all about gears in a time that just happens to have involved cool looking hats and coats which endlessly amuse nerds the world over? Obviously I'm going to say no, because that's my thing!

I think that gears are part of a rigid, disciplined, military approach to technology. Gears have to be damn near perfect or they won't work. The number of teeth must be exactly correct, perfectly regular around the gear or it won't work at all. A single broken tooth can often render the whole gear useless. Small amounts of just about anything getting in the gears can cause them to instantly fail, possibly permanently. Or slowly get worse over time until they wear out and are totally useless as anything but scrap. Gears also often require a huge mechanical stress locally on the teeth, meaning the quality of steel used matters, again raising the bar to create the thing. Gears are a very accessible technology for a huge military power based on extraction of resources and mass deployment of industrial labor. They create a priest/engineer class who can design them, a working class who has to work with discipline and focus to create them, and a helpless user class who consumes them but cannot repair them ever. Gears are a symbol of military industrial power because they can only be created by that type of power. They also turn around and regulate that military society that built them, being an essential technology in the development of clocks through the rise of the European empires.

Just as space is a symbol of military might today in part because of the power vested in GPS satellites, clocks were a symbol of military might in the rise capitalist empires because you need a good clock to measure longitude on a long sea voyage. So those gears as used in clocks translated very directly to real military and economic power which was wielded mercilessly on the whole world to bring yet more military and industrial order to the world under the British Crown(and others). Today the power of precise time is both centralized and distributed: thanks to the cell network, everyone has access to extremely high accuracy time and position data both. And of course the role of clocks in people's lives in capitalism is yet another example of industrial precision enforced by military force, telling people when to work, when to rest, when to eat, etc. and threatening their livelihood("job") if they do not obey.

Ok, but what does it mean to turn our backs on gears? Don't we need them? Well, sometimes. But not always. Gears let you transform the mechanical impedance of a system, that is, trade off speed for force, going from fast/weak to slow/strong or vice versa. That is indeed very useful, but is that the only way to do it? No. There are many clever systems of levers, belts, pulleys, and hydraulics that can also do the same basic function. In some cases a problem is simply way better solved with a gear than some type of belt. But did that problem really need to be solved? I believe that it's often necessary to reconsider which problems we really want to solve, and try to avoid the kinds of things that need gears. One of the ways we get stuck with gears is that they’re easily to integrate into the existing motor technology. I’ve developed products that use electric motors with gear boxes. This technology is cost effective, rugged, and functional. It’s also loud and very difficult to reproduce outside of a giant factory. I’d ditch it if I could, but given current state of the art for motors that’s not an option and I’m stuck with the noise.

Attacking the assumptions made in choosing to use gears is one of the reasons it makes sense to get down to the root of how motors are made and build it back up from nothing. I want motors that don’t require expensive machinery to manufacture into products, and that don’t enforce rigid discipline on the design of the products they get used in. This means they get built with the transformation of speed and torque in mind right from the start, but also with the flexibility to have that be done in many different possible ways. For now, for me, I think that means v-belts and pulleys. And some plain old levers for reciprocal action motors.

So my revolutionary manifesto in regards to gears is this: let’s build something much better, and then no one has to monkey wrench any gears–they’ll all fail on their own without anyone’s help!

BFC's(Big Fucking Capacitors)

One of the things I’m committing to with this blog is rambling on about physics and engineering topics about which I’m fairly ignorant. That’s sort of my thing here. To that end, I’m going to talk about high voltage capacitors for energy storage.

Here’s why I am attracted to them: they can be found in junk heaps the world over in old TVs and monitors as well as other electronics, and they can charge up FAST. So if you want ubiquitous energy storage over short time of the kind you’d use in the squats and communes of the future, not the kind Elon Musk builds for you, this is really ideal. Now hold on, you say, the energy density of these things is low! And how much energy can you really store in a 1000 uF capacitor? Ok, sure, but energy is (1/2) C V^2, so voltage matters more than capacitance. And if you built your mechanical energy harvester as some kind of crude high voltage generator(more on this later), you can get several kilovolts. So, say it’s 3300 V or so, that squared is about 10 million, multiplied by 1/1000 of a Farad(say it’s 2000 uF, divide that by 2), you’ve got 10 kJ. For comparison a AA battery with 1300 mA-h, which is what my rechargeables have at 1.5 V is 1.5V*1.3A*3600 s = about 7 kJ, so it’s comparable to a AA. Except those AA’s I have take overnight to charge and this can charge off of some pretty random mechanical motion over just a minute or two. Embed it in tons of silicone for safety and build simple step down circuits and you’ve got something way better to the trash wizard than any battery.

Also, for motor applications, I think the HV might work in some cases. A sort of railgun style drive applied periodically could be useful for certain resonant motors. And electrostatic motors can be useful for working with some of the micro/nano fluidics or NEMS/MEMS that go along with the vibrational engines.

Demos and the Narrowing of Focus

I want to have demos available concurrently with releasing the initial Trash Wizard book. But what, exactly, has to be built for that?

Certainly, as said yesterday, a first demo is the coil winding machine.

But I think another even more basic demo is the small(about 1/4 inch diameter) cylindrical magnets on a strip of folded duct tape, which can be moved around to opposite alignments along a main axis of a drive coil. The duct tape is meant to be floppy but not very stretchy, and can be taped to anything. This demo is a fundamental element to both pumps and propulsion. I could imagine this being a pushing element that goes at the tip of a rod among many radiating from a center, in a ball, that rolls. This is the more rigid version of the tentacle ball robot. I think it could be done with just six rods, with one drive coils per rod, so only six coils and six magnets. Accelerometers and pickup coils can combine to control the whole thing as it bounces, flops and rolls around. These can be made for next to nothing out of trash. They can also all be programmed to herd together, but not run on top of each other, much like sheep, and to all have a herd sense of where they want to go, again like sheep. The Trash wizard stick then acts like a shepherds crook: a generic tool used by the trash wizard to herd(rumble) rumbles of robots. This is important in the long run for gathering materials and many other applications, but in the short run it is great for publicity and fun/art. Another application is moving data from one place to another, and networking. Routers can be in all the robots, making the network of robots cover space to create huge ad hoc networks.

The above paragraph again loses focus, however. The robot demos are very important for publicity but for funding nothing beats pumps. A reversible pump built into silicone for lab-on-chip biological and chemical applications is, I think, the most fundable of the various choices in the short term. That can be scaled up for cooling water pumping and maybe bilge pumps.

Possible grant proposals:

• Water pump from trash for free technology in developing world, funded by development NGOs like Gates foundation

• microfluidic reversible pump for lab on chip applications using PE motor

• Robot rumble based on free motors used for clearing mine fields in developing countries from trash. Could get funded by any military or aid agency, private personal donations

• Pumps for ultra-high reliability water removal, from bilges and sumps, could be a crowd funded product, “commercial product”, funded by Navy or Marines

• Integrated vacuum pumps for micro vacuum spaces for gas discharge applications, atomic vapor cell applications. Demo includes simple pressure cell showing rough vacuum, and a hydrogen arc discharge cell that uses a built in high voltage generator to get the voltage and a electrolysis machine to get hydrogen out from water. Funding from all branches of all agencies that do atomic physics(e.g. atomic clocks etc).

• integrated fluid pumps in silicone for pumps in soft robotics–collaboration with soft robotics experts, with their funding streams

• Refrigeration using vacuum pumped water. Funding sources for really-free technology that does cooling can be just about all of them: non profits that promote development, all the major military agencies, etc. Access to refrigeration for free that can be scaled up also for free can be a life saver for millions of people across the globe.

So it's clear that most of the next task should be focusing on vibrators way above resonance, and integrating them into silicone fabrication for pumps. If that technology becomes robust and buildable out of trash, it can be the core of everything in terms of getting funding to scale up the project and pulling more and more people into the system. This means the next two priorities are the v6 of the control board and getting some nice driven-way-above-resonance demos of magnets of floppy things.

First Report of my L/R Measurements

This will be somewhat disjointed since I'm prioritizing writhing something now over making real documentation that someone can follow. This is not a manual for how to do this, just a report on what I've done so far. The circuit I've measured is as follows:

I'm modelling the inductor as a ideal zero resistance inductor in series with a resistor. Obviously this is not totally accurate for several reasons, but it's pretty accurate, as we'll see, and shows the physics I want to see. Using a transistor control board and a Arduino UNO, the voltage Vin is pulsed from zero to Vcc quasi instantaneously as the transistor is turned on. Since the circuit is connected to Vcc initially, turning the transistor on takes the measured Vout from Vcc to a voltage that changes in time to an asymptotic value of Vcc/(R_bias + R_inductor). I won't go into details here as it will be in the more technical writeup, but we can solve the differential equation for this system by inspection and see that the solution is an exponential decay from the start voltage or current to the asymptotic value, with a characteristic time given by L/(R_bias + R_inductor). Here is a photo of the breadboard part of my setup:

You can see the resistor there, it's about 2.3 Ohms(measured on handheld DVM). The DC resistance of the coil is about 3.1 Ohms, also measured on the handheld DVM. Power supply voltage is about 5V so in the end this thing is ramping up from zero to a current of about an amp. In the experiment I take a tap from between the coil and the bias resistor over to the analog input of the Arduino UNO and write a program for the UNO that turns the transistor on , records about 8 ms of data, turns it off, and waits for about another 100 ms before repeating. I then write simple Python scripts that record and plot these data. A plot of a single trace of raw data is shown below:

This is a 10 bit analog to digital converter, so the scale is 0 to 1023. The voltage from ground to the top of the bias resistor is thus going from about 5V to about 3V. OK, that's not quite right because I drew the schematic and set up the breadboard opposite to each other: actually the bias resistor is closer to Vcc not ground, but that has no affect on what follows since I'm normalizing that out anyway. Because I want to take the log of the exponential to get a linear function that can be easily studied, I need to first normalize by removing the offset so our exponential approaches zero:

Now for simplicity I normalize so that the start value is 1.0 and everything that follows is in units of a fraction of that:

And that is just a graph of the function y = exp(-t/tau), where tau is the exponential decay time. So now we can just take the natural log of this to get log(y) = -t/tau. To remove statistical fluctuations I took 100 averages of this experiment(which takes about 10 seconds). The following is a plot of that log with a line fit by inspection drawn over the points:

This shows that until the signal gets down to the noise floor(at about 3.5 ms), it obeys a exponential pretty well, with a decay time of about 0.54 ms. There are visible deviations from linearity which I believe are the nonlinearity of the ADC for the UNO(they are repeatable and do not go away with averaging). Now if the L/R time is 0.54 ms and the total resistance is about 5.4 Ohms, we get an inductance of about 3 millihenries(0.54 ms*5.4 Ohms). I believe that is reasonable for a coil of this size and number of turns. Also a quantity worth computing is the L/R time intrinsic to the coil, without the bias resistor. That is 3 mH/3.1 Ohm or about 1 ms. I think that's the experimentally relevant number to this motor project. 1 ms is about as fast as I can expect to be turning the thing on and off, at least in terms of orders of magnitude. Not that I want to go faster than that for any reason, but it's useful to have that number in your head for design. I personally like everything about this measurement more than AC measurements of inductance for learning. The way I learned about inductors in school was first as mysterious things that make magnetic fields for no apparent reason, then as an AC element which honestly was also pretty mysterious. Not the equations governing it, we learned those fine, but WHY you would want one or how you would use it in a practical circuit, or anything about motors really. I'd like to see this combined with the RC time constant lab, and both of them studied via step functions like this rather than AC. It's typical in overly theoretical treatments to deal with a step function like this with Laplace transform methods but that's really not a great idea in my opinion. Sure, learn that if you want to learn ODE theory, but you can write down the equation of motion as well as its solution here purely by inspection and physical insight, and forcing students to understand Laplace transforms in order to understand this system is really bad, I think.

Free Hardware

What does it mean for hardware to be free?

Free means that a thing can be created with only labor and the waste products of the old world or renewable products of the natural world, using information that is available to the public both physically and logistically.

• If someone claims the legal right to control who can make a thing it is not free.

• If materials mined or otherwise extracted from the Earth are needed to make a thing it is not free

• If professional expertise that cannot be learned in a short time from clear online instructions are required to make a thing it is not free

• If a tool from the consumer capitalist economy is required to make a thing(e.g. a 3d printer from a factory) it is not free

• If the fabrication of a thing requires the use of energy from the Grid or non renewable sources, it is not free

• If a thing cannot be re integrated into the industrial ecosystem in a modular way after its lifetime it is not free

I seek to build a motor that is free in the sense described here. I think of free as that which is not unfree, where unfree is defined by a list like the above. or:

• A free thing can be made from readily available waste *streams* of the existing industrial capitalist system

• A free thing is not patented and is disclosed publicly in sufficient detail to make patenting illegal

• A free thing has publicly shared non copyrighted instructions which enable a non expert to learn what they need to learn to complete the construction of the thing

• A free thing can be fabricated in a scalable way, from single units up through millions of units, with automation at large volume using robots built from same technology

• A free thing uses only ambient energy to function

• A free thing has a post life trajectory built into the design, where all components are easily salvaged into other Free Things

• The construction of a free thing must create value from “nothing”, which can be a medium of economic exchange outside the world of central bank debt

It’s clear why I have to start with the motor here: without a free motor, it’s impossible to build anything else free because it would require automation using motors from the old system. With a *class* of motor that can be built to many specifications, a whole electromechanical technology can be built from the ground up that is all free in this sense.

What is the connection between free hardware and open source hardware? Open source hardware does not at all have to be free: it can require a vastly expensive factory to actually produce, as long as the design is publicly available. This maintains the power relationships of industrial capitalism: the means of production remain safely in the hands of the capitalists, we are just re-aranging how we share amongst ourselves. The difference between free and open can be more subtle for software where it’s always free in the sense that it can be copied an infinite number of times for no cost in principle. Hardware on the other hand is not just information. Without supply chains that are wrested from the control of the masters of the system, what is or is not free is affected very little by “open source” hardware.

Another important shortcoming in the open source model is the lack of demand for the project to be accessible to those outside the technical guild that built it. This is not as bad as it used to be, but it’s still common practice for “open” to mean a thing has horrible documentation and usability as contrasted to “closed” commercial software. What this really does is *further* enforce the class divisions in capitalist society by making a hierarchy of who gets free stuff and who doesn’t. Those who are in the software tech guild can get free things that are unusable to a normal person, and which have such opaque help that no one outside the guild can be reasonably expected to figure it out.

Avoiding this shortcoming of open source software in the free hardware project will be particularly tricky. This means that if you want to use a permanent magnet and coils of current carrying wire for a thing, the quality of applied physics education you make available to your user determines the freeness or non freeness of your technology. That means that any free electromechanical technology is not really deployed until a whole curriculum is made freely available on classical mechanics and electrodynamics. That curriculum must be held to much higher standards than are presently applied for college or high school physics education. It must be very applied, with direct numerical examples throughout which can be used live using python notebooks. Also it must be able to cater to a very diverse range of learning styles: hands on, mathematical, theoretical, visual, etc etc. *All* of these must be made freely available in multiple open free formats. It must be possible to do this with printed pages and no computer or with any type of computer or personal device and no printer(either).

When the thing is built, it must have information printed on it or embedded in some obvious way, which links back to the main free storehouse of documentation. That documentation must also be decentralized to prevent any authority from destroying the information.

This imperative really affects the way that progress moves along. A working wire coil is not enough. It must be well characterized and documented with a series of easily accessible physics experiments. There must be youtube and instructables content showing how to put it together. These experiments lead to a very fractal level of digression, but in the end they lead to absurdly robust technology which can be recreated from scratch by anyone anywhere quickly.

I'm pretty sure the next physics thing I need to get working on the motor that's not for motor function is the LRC demo. I want to see a damped LC oscillator, measure Q and resonant frequency for a few C values to determine L, then see how L is affected by various high permeability objects placed in or around the coil.

Then I probably want to make a nicer coil winder with a hand crank, buy one more round of 24 AWG copper wire, and wind a bunch more coils, then back to real motor design with the stick frame.

Frequency measured (crudely)

Ok! I can now get frequency out in real units(Hz) as a floating point. I do this by finding the first and second zero crossings, taking the difference, and assuming that that is half of the total period. Then convert to float and take the inverse and you have frequency. Also I've edited the getAmplitude() function so that it returns a value in mV instead of arbitrary units, by scaling to the 5V of the Arduino and also the 1023.0 of the maximum value of the ADC.

if(stringOne.startsWith("getFrequency")){ int zeroCrossing1 = 0; int zeroCrossing2 = 0; for(index = 0;index < numPoints – 1;index++){ if(x[index] > 0 && x[index+1] <= 0){ zeroCrossing1 = index; break; } } for(index = 0;index < numPoints – 1;index++){ if(x[index] < 0 && x[index+1] >= 0){ zeroCrossing2 = index; break; } } int halfT = abs(zeroCrossing1 – zeroCrossing2); halfT = halfT*dataDelay; //convert to ms float measuredFrequency = 1000.0/float(*2halfT); Serial.print(measuredFrequency,2);//frequency in Hz to Serial.println(); Serial.flush(); }

In other news, I seriously need to figure out how to embed code in this thing so it doesn't look all weird and my indents aren't broken. I use indents! Really!

Getting amplitude of response

Finally got amplitude function working. Last night it "worked" in that it was returning the correct numerical value, but like a jackass I put the Serial.print() statement *inside* the for loop that counts to 500 so it was spamming the serial feed with the damn number 500 times and I was too tired to know why. Moved to outside curly brackets and now there is harmony. if(stringOne.startsWith("getAmplitude")){ int minx = 0; int maxx = 0; for(index = 0;index < numPoints;index++){ if(x[index] > maxx){ maxx = x[index]; } if(x[index] < minx){ minx = x[index]; } } int amplitude = maxx – minx; Serial.print(amplitude,DEC); Serial.println(); Serial.flush(); } Note that I don't give any shits what you put after getAmplitude, it could be getAmplitude(), getAmpitudefffdddfdfdfdfdfdfdfdfbutt or whatever, as long as it starts with that. Still need the camel case though. With this working, I can move on to the frequency function, then move over to python coding to start making the data taking and control stuff I really need to make the pretty pictures.

High Voltage DC electrostatic motors

Water has a HUGE dielectric constant. But if it has junk in it it conducts electricity. So with distilled pure water constantly available, it may be desirable to do mechanical work immersed in clean distilled water, so that the force of the various electrostatic motors is multiplied up by this dielectric constant. Of course the drag of water is huge compared to air and vacuum(in this case just mechanical losses of the moving piece of material), so that can be an issue based on speed. It's a tradeoff. If you want really fast things to happen you need to have no fluids around, but if you want more force slower, you want to be immersed in water for the tiger force. Again, it's the concept of mechanical impedance, and water immersion is the choice for high impedance while vacuum and gas are for low impedance. Development of this technology should happen in parallel in vacuum, air, and distilled water(and maybe some non distilled water, where current might be useful).

Also electrochemistry is useful. Electricity combined with fluids and various metal sources can be used to move metal atoms around from one place to another. This will be a fantastic way to grab hard to get atoms from a submerged junk car. Again, these techniques reward patience: given enough time it should be possible to get just about every single atom of a junk car out and used in something, even if in some cases it takes years. But if it is reclaiming dead land, does not cause harm, and takes no significant human labor, who cares? Let it eat the car. So one member of the early team is an expert in electrochemistry. What else do we need? Perhaps a cadre of professors with existing programs that line up with the overall mission is needed. I need to compose the list of experts next.

I made a 3 phase motor and it was crappy

I finally made a motor with three coils in a triangle. It was a healthy reminder that this is what I'm fighting against in my design philosophy. Why do I hate motors as they are designed now? Because they're not human technology. They work "well" in efficiency, power, or whatever else engineers choose to optimize for but they are touchy.

If you crudely make a triangle with duct tape and 3d printed hand wound coils, then tape some magnets to a shaft in a couple ball bearings and drive the field around in a circle, it sucks. You can make it spin fast and with a reasonable amount of torque, but it stalls totally at random and reverses direction, oscillates, etc. It's bullshit. Now, I'm doing a lot of things shitty here, so it's to be expected. I have no feedback, am not bothering with PWM, just doing all on or all off, use only one direction for each coil, and only sort of have the coils lined up right, and there's some lateral play in the position of the coils relative to the shaft, which also wiggles. But that same setup with just a single coil, with just one direction and no PWM, works comparatively smoothly. It's bidirectional, but doesn't stall very easily and restarts quickly. Pretty much any distance will work for driving the magnet, and any magnet shape, etc. So a human can get it all tuned up by hand trivially with any of many possible arrangements.

And that is the goal!!! Human technology, that you can modify and understand easily, that you don't have to be some fancy pants engineer to use or understand or modify. What was missing until today was a way to use my system to apply a bias to the direction so that you can have the motor go one way or the other and select that with software. I think there are a lot of ways to solve this problem, but my solution is: two drive coils, angled about 120 degrees from each other, next to each other, with a sense coil between them pointed in toward the same center as the drive coils. One drive coil is repulsive and one is attractive, and they're triggered by the sign of the EMF in the pickup coil. The flux maximum and minimum are when the magnets are aligned or anti aligned with the pickup coil, so this is where the time derivative is zero, so also where the EMF is zero. Thus that line of symmetry between he drive coils defines the line of sign change of the drive. Switch which coil is triggered by which sign and you switch the direction.

This simple system should work to make controlled motors that can switch direction for turning wheels with some torque. That means I can make a wheelie cart controlled over the wifi network as well as a coil winding machine, both of which are important milestones in this project. Also, I *think* a small variation of this should work to drive magnets around in an oscillatory orbit in one direction or the other, possibly working for pump action.

i made a thing, and maybe someone cares

Well, I've made more of the latest weird circuit board I'm working on. It doesn't really have a name, other than "coil drive board version 3". Basically it's a Arduino pro mini clone but with a drive transistor that can drive up to 2 A and 60 V to drive a coil, and a op amp to measure another pickup coil, two buttons, a knob, a couple other breakouts, an on/off switch, a pilot LED, and a DC power input connector.

The code on the micro controller lets the user switch between two modes in the current version. In the first one, the user can push button to make the drive coil go on, release it to turn it off, and it spits out data from the output of the op amp over the serial which can be graphed on the new Arduino IDE(1.6.6). The second mode is where the magic happens: the amplified signal from the pickup coil is fed back to determine when the drive coil is engaged. Thus a force is applied always with the same sign as the velocity of the driven permanent magnet, making a dynamic resonant drive. I.e. as the thing is driven harder and the frequency changes, the drive moves to adapt, and it always hits resonance.

This makes a fun toy where you can put a magnet on pretty much anything: a spring, a long thin popsicle stick, a long springy steel rod, a springy door jam, a pendulum, or a lamp, and see it resonate mechanically. The resonance can often be changed in simple ways by pushing harder on a spring or moving parts of a system around.

Showing this to friends, someone got VERY excited and wanted to take one home to resonate all the things. The danger of physics PhD's for these things is they have a distorted idea of what a normal person would want to buy. NO connectors? no problem. No coil? i'll wind one! Ok, that's cool, but this thing has a ton of work before I could even call it a product much less a viable one. Do people want a weird stick that resonates things? Maybe. I mean it's super useful, and in the long run I think everyone will want this technology, but as a weird toy between experiment and product? Maybe. Whatever. I'm going to finish a few more identical ones, test them, and hopefully get all the files up on github so anyone who wants to can build it. If that results in interest, maybe we'll sell a cheap kit or something.

Mulling rotation direction

Well, I made a motor that spins, and it's really fun! The feedback is as in the vibrational motors I've been making, and it just pushes the magnet whenever it's going away then is off as the magnet spins around. This gives fast and strong rotation as long as there is a reasonable bearing of some kind, and as long it starts going the direction you want it to.

There are a couple problems, however: a lack of direction and the half period during which there is no drive, when a stall can happen.

An obvious and clearly workable next step is to go up to a full 4 coils, and ping them all in order as in a DC brushless motor. But I don't want to jump into that too fast. My goal is not to reproduce the DC brushless motor, my goal is a motor that truly can be built and understood and modified by non experts. One of the requirements here is that I don't just want a unique design which works and can be copied. I want a class of designs which are so clear that almost no prior understanding is needed to make it work, fix it, and mess with it. What I want is a directional feedback, a very simple way that a pair of coils can have a feedback drive like what I have now, but with a second axis added and the relative position of the second coil determining the direction of rotation. This can work for linear drives, rotational drives, part of a rotational drive with multiple coils, or resonant orbital drives that are used for bouncing robots and possibly ornithopter drones.

So I'm going to pause to slowly mess around with the phase of the second pulse and the position of the second coil, and get that smooth before moving on from the rotational motor. If that works, I should be able to make a simple wheeled robot that can be directed around over bluetooth or wifi. I can also make a simple magic wand style vibrator out of this version of the motor, although that should not need as sophisticated a drive(since direction doesn't matter).

But if I'm going to stay focused on the main long term goal, the first thing to make with a rotational motor is a coil winding machine. Then I need to figure out how to make the coils from a found object, how to make that in bulk, and actually go out and make 100 or so of these things. And build the beginnings of a magnet supply chain, do some snooping on how to dumpster the hard drives I need around Denver. Then tighten up the design of the control board, get some more ordered and assembled and tested, and FINALLY get into the energy storage side of things. Then ARM controller, internet connection, software, more robots, build ice factory.

Project power

One thing that's always frustrated me about learning electronics is the power. Most small electronic things you actually use run on a small number of AA or AAA batteries, a lithium ion polymer battery, a USB connection, or some other wall wort type power supply at typically 5 or 12 V.

So if I were going to teach someone how to make a thing, shouldn't it start with that? I'm tired of stuff where the default is +/- 15 V. Also 5V but with no useful connector information. And switches. Buying them sucks, figuring out which one to get sucks, and they're generally not built into project boards. What I'm going to do here is share my favorite ways to deal with the power issue in boards I get made for random cheap little electronics projects. First: batteries. This product is so awesome:

http://www.digikey.com/product-detail/en/2462/36-2462-ND/303811 (http://www.digikey.com/product-detail/en/2462/36-2462-ND/303811)

You solder this into your board on the back side and you've got a compact self contained thing when you're done! Perfect for…well, just about anything. 3V is pretty useful, I use it for everything including the Ambrosia vibe. In any kind of volume it's under a dollar, and adds very little volume on top of your battery and boards.

Now for the on/off switch:

http://www.digikey.com/product-detail/en/GPTS203211B/CW181-ND/3190590 (http://www.digikey.com/product-detail/en/GPTS203211B/CW181-ND/3190590)

Simple on/off button, under 1 dollar, easy to solder in your board. I also generally try to have a green LED somewhere with a resistor in series for a pilot light.

But there is one more thing. If you're using a micro controller AND some kind of high current thing like a motor, you need a DC/DC converter fort he micro controller. I got badly burned by this for months of misery in our crowd fund but once we added the boost converter all was well. This is the boost converter I use:

http://www.digikey.com/product-detail/en/AAT1217ICA-3.3-T1/863-1496-1-ND/4246188 (http://www.digikey.com/product-detail/en/AAT1217ICA-3.3-T1/863-1496-1-ND/4246188)

That damn product changed my life. The motor or whatever can draw tons of current and pull the voltage waaaaay down, below 1 V and you still get a nice clean 3.3 V going out of your DC/DC converter.

Due to my hatred of github and laziness in dealing with it I still have not put up all my various boards based on this, but I'll try to get them up soon. Making a new thing is so much easier now that I have this template and I'd like to spread that around.

Wires and Magnets

I need wires. Lots of wires. miles and miles. And magnets. Tons of magnets.

To build motors. Many motors.

And so do you. We all need motors, and we need them from trash. Trash wizards must be making them in bulk and distributing them.

I see guys pushing and towing by bike carts of trash to the big metal recycle plant by where I live all the time. For the metal they get paid minuscule amounts of money by the pound, and it's all crushed and melted and turned into new products for the consumer economy. Meanwhile while the copper or aluminum is preserved, the most valuable parts of the things are all destroyed: the structure.

I mile of continuous wire with no kinks and no breaks in the insulation is worth exactly the same amount as the same weight of copper in the form of the busted up remains of a copper drainpipe. How can that possibly make sense? It costs energy and time and other resources to turn raw copper into wire. And of course tons of energy to melt it down, reform it, put it into some over designed consumer shit product, and shipped to a customer so they can use it for a while and sent it back to the trash cycle.

Dig it up, set it on fire, trade it for some form of debt, and bury it. That's our civilization in a nutshell.

But I want to amend this. If you bring me a mile of good wire, that has value, real value which can be the basis of further economic activity. While a smashed up drainpipe of copper also has value, it's fundamentally different. But that's quantifiable and again that has real value, as does the labor of the person who found it and brought it in to the factory. So that's the proposal. Bring rare earth magnets and copper wire(from the consumer economy's waste stream) into the factory, which is local, and you get credit within the economy of that supply chain. Now maybe the factory makes a motor with those wires and magnets. Then ships it to another factory collective that uses a bunch of them to build some sort of food processing machine, which is shipped to the food store, where the person who delivered the copper now buys food. No federal reserve debt, no fires, no burying and no digging up the dirt.

My task is to quantify the parts of this supply chain. Much wire lore must be studied, and ways of quickly determining quality and properties with available materials must be found. A similar toolkit must exist for permanent magnets. This is what applied physics should do.

More forks in the road

Well, I got the chiral resonant motor to basically work. That is, two drive coils and two magnets, along orthogonal axes, are coupled and driven so that they can make a central mass move in a clockwise or counterclockwise orbit, but with no net rotation–this basically works. And I can see how to scale it up, scale it down, run it with a bigger or smaller mass etc. But what to do first? what are the priorities.

Here are some choices:

• build a larger rig from more skeletron parts which has a fulcrum and a lever arm and separate spring ring that can make a rod of any length orbit with a large clean orbit one way or the other

• work on the positions of the sense coils and on the code to try to get a smoother version of both

• make a nice self contained compact massager based on existing version(crude rubber band springs)

• write better documentation so that others can build this

• go recruit people on social media who might want to build versions of this

• start putting stuff on youtube

• work out the theory of various versions

• work out the theory of the electrostatic driven version at the sub mm scale

• focus on fulcrum design: gimbal? silicone blob? springs built into it?

• study the sin/cos functions, figure out better standardized way to characterize the phase angle in the feedback code

I'm going to do all of these eventually. But on writing them down it's clear what's next. The demo I have doesn't really function for anything useful and is not repeatable enough to warrant distribution.

1. Making some kind of crude lever arm setup, even if it's huge and weird is clearly the priority. Build a CLEAN and REPEATABLE circular trajectory that can be easily reversed, where the lengths of both sides can be adjusted to adjust impedance, mass can be added or subtracted, rotation is avoided, and the diameter of the circle trajectory is over 1 cm, speed slow enough to see clearly, force enough to drive a crank around and make a shaft turn. All that. That must be done, all demos flow from that.
2. Also: modularity! I need to have a fixed setup with both drive coils and sense coils and the electronics all integrated so as to always work for a circular drive, including on found objects like door stops and sticks. With that built, separate from that, I can have a board in the skeletron system that has the rods, masses, magnets, fulcrum.
3. A first step is to make the magnet holding mass that lives on the end of a 4 mm aluminum rod. So I need to bake a sculpey cube with a aluminum shaft in it as well as nuts which will all be JB welded in after baking, and the magnets fit onto the clay and stick to the nuts.
4. With this rod with magnets and mass finished, dig out existing silicone fulcrum and find a way to fix that to a modular board(stick-board not PCB). Then string up bolts to connect rubber bands to just short of the mass/magnets.
5. THEN, when all this is put together, choose locations for both sense coils so that x and y are both MEASURED. Fix in place in simple repeatable location. Probably right under each coil is best, it captures x and y in the simplest most repeatable way.
6. When coils are in place and full level arm is in place, clamp them together, clamp them to the desk, and then add a knob to the PCB being used. Then start experimenting with the code, having it measure theta in various ways while spinning the thing around manually. Also make a simple dumb drive where the knob determines frequency and the two coils are each doing about 120 degrees of push and the knob just sets the frequency.
7. After all these experiments, think hard about the math and re write a very simple version of the code with feedback.
8. Then test, mess with all components, re-test.
9. Then document, youtube, distribute and move on to scale up and down and make useful stuff, figure out how to scale.

Making coils

Here I'll do a brief overview of how I make my coils. This is not a real tutorial since a bunch of details are pretty sparse and you still need a 3d printer and some files and details on that, but it shows where the process stands now. I'm discussing drive coils here, and will describe the sense coils elsewhere(those are 30 AWG). Drive coils are always 24 AWG, with some kind of varnish type insulation like polyamide. Here is a 1 pound spool of the stuff I bought off Amazon:

Notice that it's on a stick which goes through my desk so that the spool can spin freely during the winding.The driver for the winding is a pair of 3d printed parts clamped in the drill motor like this:

The parts for the spool mold are shown here, both 3d printed on my Dremel printer:

Notice the matching keyway between these halves and the part that clamps in the drill. Also, there are 4 holes that go through both of these parts so that they can be wired together. The wires used to hold them together are of the same type: 24 AWG copper with or without insulation:

Wires are pulled tight with a pair of pliers and then twisted together to fasten the halves with a little bit of force:

This is the other side, note two wires are used not four or one:

Now another two wires are used to lay down the basis of the wires that will hold the coil together. These are fed through the slots and bent around in some way to keep them in position while the col winding gets started. This picture shows the wires in position but not yet wound out of the way:

And here both are threaded into all four slots and wound around to get them out of the way: Once that's all tidy, the whole thing is put on the key that is clamped in the drill motor:

You then run the drill with one hand and feed the wire with the other to get an even coil of wire that fills up the space in the mold like this:

Now those special wires that went under the whole coil come into play. You pull them out and cut each one in half, so that there are four evenly placed longish wires going under the coil at the four slots.

Then you wrap them around the coil and wind it tight with a pliers, bend the twisted part over and cut it off. Then cut the wires that hold the halves together. Once this is done nothing holds the plastic parts together and they should both easily come apart like this:

With that done the coil is done except for stripping the insulation off the end with a x-acto knife and soldering a 0.100″ header on like this: Repeat as needed to make more coils:

So what's next here is:

• make more coils until I run out of wire

• finish the stripping and header soldering on all of the drive coils

• build a better jig for holding coils and other sources of wire

• build a dc brushless motor from scratch to act as the drive for the coil turner

• replace the 3d printed parts with parts that can be made from sticks and trash with no 3d printer or machining

• find a reliable waste stream that has insulated 24 AWG copper which can be easily used as a free source of the wire

• build a set of parallel machines to increase throughput

• build destructor robots that can forage for copper wire

• build constructor robots that can manage the process of spinning coils, testing them, and storing them

That's going to be a lot of work, but at least I think it's a clear road map now.

High voltage generator

A magnet is forced to spin on its axis pretty fast. It spins so that maximum flux is put into a 200 turn coil, which drives a huge copper loop which drives a 200 turn coil, and again after that. So the two 400:1 transformers transform the AC voltage by the square of 400 or 40,000X. If you get a volt or so at the input coil, this should produce 10's of kV on the output coil. A pair of diodes then dump the charge into two different capacitors, one for the plus and one for the minus, or 4 diodes give a bridge rectifier.

This capacitor is in parallel with two big metal balls, with an arc gap. Demonstration of repeated high voltage buildup is shown with bridging various arc gaps. A purely mechanical high voltage generator is useful. This can immediately be applied to plasma tubes when the vacuum pump and electrolysis cells are working. By producing O_2 and H_2 in the lower voltage electrolysis cell, these gasses can be flowed through various low pressure cells, which can have high voltage discharges, showing various plasma physics. This would be a VERY high impact demonstration of several things: use of ambient energy, plasma physics from scratch, creation of clean water from ambient energy, cool zap effects that can be construed as "art", and demonstration of energy storage.

A system should be devleoped using liquid transistors to regulate the voltage from a HV capacitor in such a way that it can power philosophy engine motors. Perhaps larger coils could be used so that 100's of ohms and 10's of kV gives 100's of amps but for just a short duty cycle so that this is reasonable. Many short impulses thus delivered could add up to a good motor drive function.

A micro Freight Rail system

Freight moves using electric motors along various cables, like the sky lines in bio shock infinite. These motors use high voltage capacitors for energy sources. The needed energy is always a margin less than what the cap has, but in an emergency, a rescue unit will drag a dead sky hook unit to the next station. At each station, the high voltage capacitor is physically handed off to the local robot that hooks that up to the ambient charging station and instantly hands off a fully charged capacitor to the passing cart. Thus it can go indefinitely by grabbing capacitors and dropping them off at each station, as long as cars pass infrequently relative to the charging time of a capacitor. With infrequent travel times, say once or twice a day for some minor frieght needs, getting that energy over several hours is trivial even with tiny available energy that is very uneven in available load.

This suspended freight rail system high above the ground powered only by wind and sun and rain is surely worth building as a demo as well. Should be very impressive, and easy to deploy in very wide ranges of environment.

Free Energy

What is free energy? Usually this term is used by various conspiracy nuts to describe ways of "getting energy for free" from something like the zero point quantum energy or the Earth's magnetic field. Both of these are nonsense, as are all the free energy schemes presented throughout youtube and the rest of the Internet.

No, we are told, energy is not "free". It has to COME from somewhere. But this notion is based on a capitalist world view. Energy is deemed "free" if you don't have to get it from a mine and labor. Renewable energy is not free: much labor is expended to build the infrastructure out of mined minerals which have a finite lifetime and eventually go to landfill to be replaced by more mining and labor.

But if free energy is energy that can be useful but is not derived from mining and labor, then free energy can and does exist. Energy not spent on air conditioning when you build under a shade tree is free energy. Energy from the sun that warms through your front window is free energy. And the electrical energy stored in salvaged rebuildable capacitors from salvaged rebuildable robots storing ambient energy is free.

Capitalist logic always looks for ways to show that things are not really free, because capitalism is based on the ideas that value comes from labor and mined minerals. If we approach industrial development from an anarchist perspective, however, we seek to build technology which is truly free, where no mineral extradction is implied in its construction.

A technlogy is free when it gives more than it takes. For instance a robot might require a few hours of service from human labor once a year. But if it does the equivalent of even just a few hundred hours of human labor it has a net negative cost in labor-value. In terms of minerals if it is built from minerals that were polluting the world around us, the mineral cost is negative: as opposed to subtracting value from the land as mining does it adds value to the land. And finally the energy of the technology must be free in the sense that it absorbs from something unwanted elsewhere.

Ultimately what is being built here is a form of artificial life. Life takes only what can be given from somewhere else. Our technology exists in a world where humanity is God. This all goes back to the notion that the structure of our technology is based on the monotheism of its initial architects. We have built a technilogical world where Man is God and only God is above Man(to use biblical sounding gibberish).

But this technology will be alive, will exist as animals and plants do, without a God. This means that while it needs humanity to help it survive at all stages and can easily be controlled by humanity it will exist on its own and can funtion to a large extent on its own, following it's hardware-progammed logic to find what it needs in the environment to keep living and carying out its mission.

Demo/Art Piece: Hydraulic Jacob's ladder

Falling water spins a wheel which spins magnets which drives flux through a many turn coil which drives current through a single turn fat copper loop which couples to a many turn coil via high coercivity material, and then a second stage again, to create high voltage which strikes arcs which rise and vanish in standard Jacob's ladder manner. The Jacob's ladder can work with just AC, no diodes or capacitors should be needed.

A fancier version would involve using some of the energy to create H2 and O2 gas which are directed upwards into the arc, making a more explosive fire/electricity show.

This AC Jacob's ladder might be simpler than the DC van der graaf type generator with big caps or metal balls. Build them all.

ALso not that building all this stuff does not require that anything on the motor side work. I just need to build a water driven shaft on a bearing which can be done with skeletron which spins a magnet in a coil. Then more winding of coils and finding the right types of wires is all that's needed.

Big Fucking Capacitor Multi Stage

Some capacitors in the system are going to be kV or 10's of kV. But I think that for a lot of electromagnetic motor stuff it makes sense to discharge not the high voltage cap but a lower voltage cap which gets refilled on a very low duty cycle with short pulses of current/charge from the big cap to the small cap, and if the duty cycles don't match right, a bunch of intermediate caps can get loaded and unloaded in series.

HOw to do the switching? I think a mechanical oscillator with a mechanical switch might work, with extremly low on resistance, near infinite off resistance, and potentially a built in low duty cycle. MEchanical oscillators can be driven with the standard feedback wand, and bounce a copper contact off another copper contact just at one end of oscillation. Changing the equilibrium position of the oscillator changes the duty cycle, and changing the spring constant or mass can change the frequency. This style of mechanical oscillator driven with dumb feedback could also be used as the switch in the boost converter, switching the current from a lower voltage on and off a inductor with a diode.

In summary: Voltages should be at various different levels, from mV to V to dozens of volts to kV to 10's of kV. Storage is done with huge electrolytic capacitors at all stages. Conversion from one stage to a higher or lower is done with diodes, inductors if for voltage boosting, and a mechanical switch driven by a mechanical feedback oscillator of the kind used for all the simple 1d Philosophy Engine work.

How to avoid arcing? In some cases it will be impossible and arcing has to be ok. IN others there will be tricks that might work. Probably arcing is mostly ok.

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In [ ]:
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