

# Do-It-Yourself Time Lapse Motion Control Rig

Motion control adds an awesome dimension to any time lapse video. The effect allows your camera to move through both time AND space in a super cool way. You can find a short example using motion control on Vimeo.com at <http://www.vimeo.com/jefftolentino>.

This tutorial will show you how to build your own rig for shooting motion controlled time lapses. I encourage you to use it purely as a guide. Get creative and make improvements as you see fit! Make some awesome time lapses and have fun!

Feel free to contact me if you have any questions or comments. I am available on Flickr at <http://www.flickr.com/people/jefftolentino/>

You can also find pictures of my own rig under my flickr account, along with other cool pictures of other cool things.

Special thanks to Udi at [www.diyphotography.net](http://www.diyphotography.net) for hosting this tutorial. Udi's site is awesome by the way! Please visit it for more great tutorials!

In addition to the items in the parts list below, you will need:

- Philips and flathead screw drivers
- Hex wrenches
- Drill with  $\frac{3}{16}$ " bit
- X-Acto knife
- White glue
- Soldering iron and small amount of solder
- Tape
- A digital camera
- A computer to process your clips

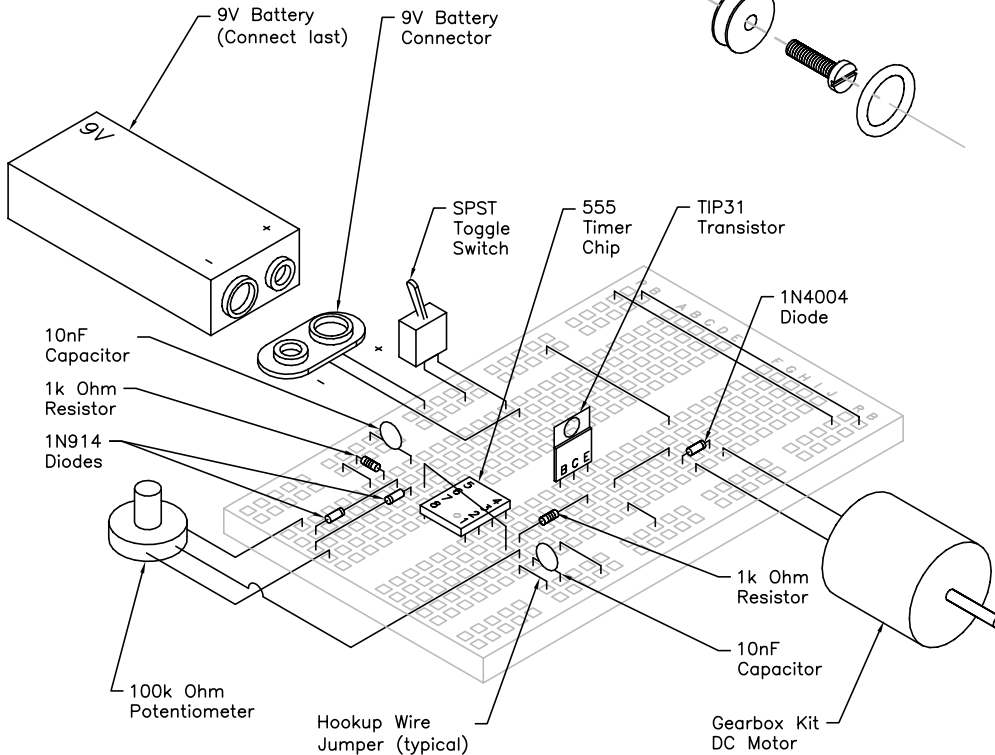
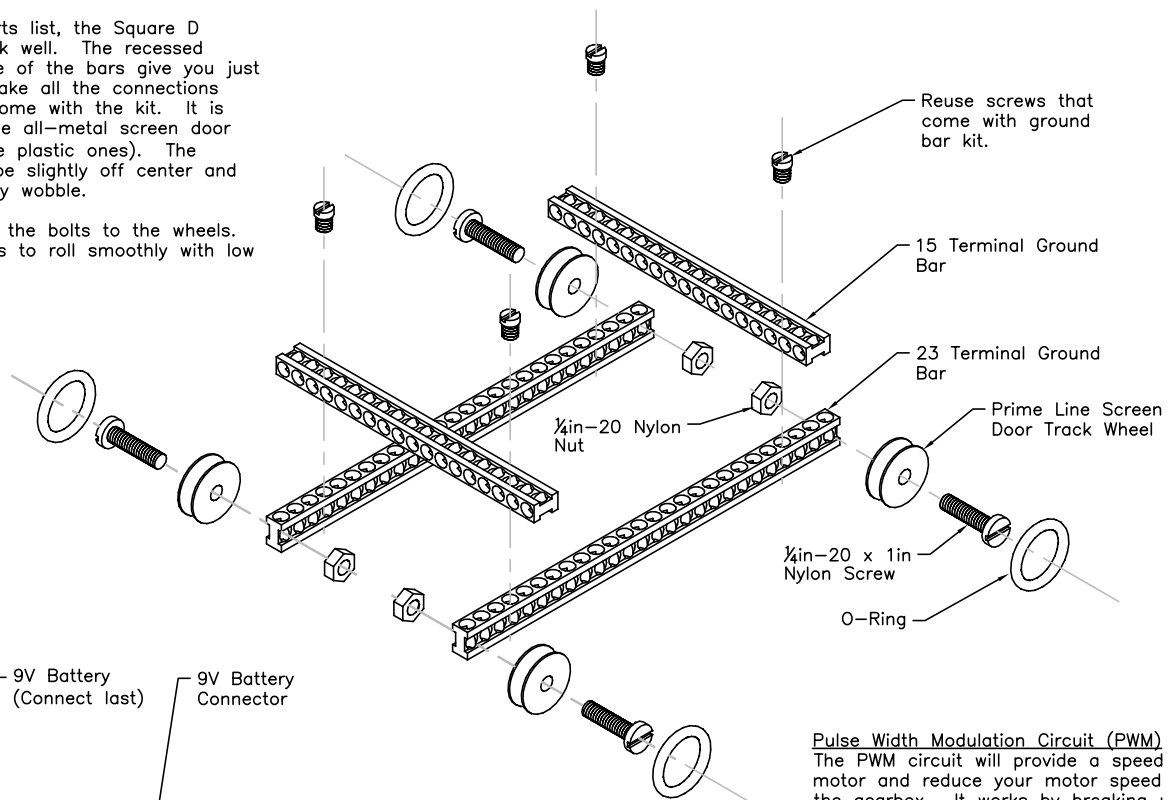
Parts List						
Component	Recommended Manufacturer	Part / Model Number	Recommended Source	Quantity	Cost	Comments
PWM Circuit						
Solderless Breadboard	Radio Shack	276WBU301	Radio Shack	1	\$8.99	–
1K Ohm Resistor	Radio Shack	271-1118	Radio Shack	2	\$1.19 (5 pack)	–
100k Ohm Potentiometer	Radio Shack	271-092	Radio Shack	1	\$3.19	You will need to solder a few wires to this.
Silicon Switching Diode 1	Radio Shack	1N914/1N4148	Radio Shack	2	\$2.99 (50 pack)	–
Silicon Switching Diode 2	Radio Shack	1N4004	Radio Shack	1	\$1.19	–
10 nF Ceramic Disk Capacitor	Radio Shack	272-131	Radio Shack	2	1.89 (2 Pack)	–
555 Timer Chip	Texas Instruments	NE555/TLC555	Radio Shack	1	\$1.99	–
TIP31 NPN Transistor	Texas Instruments	TIP31	Radio Shack	1	\$1.69	–
SPST Micromini Toggle Switch	Radio Shack	275-624	Radio Shack	1	\$3.19	You will need to solder a couple wires to this.
9V Battery Connector	Radio Shack	270-324	Radio Shack	1	\$2.99	–
9V Battery	Radio Shack	ULA9V	Radio Shack	1	\$3.79	–
Hookup Wire (22AWG)	Radio Shack	278-1224	Radio Shack	~2 ft	\$7.39 (75 ft)	You won't need very much. If you have some already, don't buy a new roll.
Gearbox and Drive Shaft						
Gearbox Kit	Tamiya	72005 (6-Speed)	Pololu / Fry's	1	\$13.95	6-speed Tamiya model recommended, but other models may work as well. Motor should be 3-6 volt and drive shaft should be 4mm.
Pen	Bic	14886/13726 (Ultra Round Stic Grip)	Staples	1	\$2.29 (12 Pack)	Other pens are fine, as long as the inner diameter of the casing fits the 4mm Tamiya drive shaft.
$\frac{7}{8}$ " Cup Hook	–	15691	Home Depot	1	\$1.18 (4 Pack)	You can probably steal one from a cupboard.
#6x $\frac{1}{2}$ " Metal Screw	–	24752	Home Depot	1	\$3.72 (Pack)	You can probably use a spare screw you have in your garage.
Household Twine	–	18007	Home Depot	~6 ft	\$2.57 (spool)	You only need 6'. Don't buy a fresh spool if you have it already.
Dolly						
23 Terminal Ground Bar Kit	Square D	51739	Home Depot	2	\$5.95	Get the Square D type, other brands may not fit together correctly.
15 Terminal Ground Bar Kit	Square D	57033	Home Depot	2	\$5.49	Get the Square D type, other brands may not fit together correctly.
1-1/8" Steel Patio Door Rollers	Prime-Line	D-1795	Home Depot	4	\$7.34 (2 Pack)	Get the metal ones. The plastic versions can be slightly off center and will make your dolly wobble.
$\frac{1}{4}$ "x1" Machine Screw (Nylon Recommended)	Crown Bolt	86108	Home Depot	4	\$0.62	Metal is fine, but nylon produces less friction, and is slightly lighter.
$\frac{1}{4}$ " Screw Nuts (Nylon Recommended)	Crown Bolt	86878	Home Depot	2	\$0.67 (2 Pack)	Metal is fine, but nylon produces less friction, and is slightly lighter.
#15 O-Rings	Danco	96734	Home Depot	4	\$2.27 (10-Pack)	–
Track						
1"x8"x6' Board	Home Depot	914827	Home Depot	1	\$5.95	Find the flattest one on the rack, you don't want any warps or sags.
Scrap Wood	–	–	Dumpster Behind Home Depot	2	Free	Sizes can vary but shoot for ~1"x12"x3-1/2" and ~2"x4"x4".
$\frac{3}{4}$ " x 72" Aluminum Finish Nosing	–	H5493 M 6'	Home Depot	2	\$8.14	–
$\frac{1}{4}$ -20 x 20mm Insert Nuts	Crown Bolt	54454	Home Depot	2	\$2.97 (4 Pack)	You will need 5/16 drill bit to install.
Additional Items						
Tripod	Sunpac	620-620-CPG	B&H Photo	2	\$34.73	Tripods are optional. Hopefully you have one or both already. Otherwise, Thrift stores are a great place to find cheap ones. You can also forgo tripods altogether, and setup your track on crates or other items.
Ultra Clamp	V.I.O.	ANL016	B&H Photo	1	\$24.99	This is actually a handy item to use off the track as well. Great accessory.
Intervalometer	Vello/Pearstone Shutterboss	Varies by Camera	B&H Photo	1	\$49.95	Any intervalometer will do. I like the Pearstone/Vellos. If you're buying a new one, just make sure the cord fits your camera.

## Camera Dolly

Construction of the camera dolly should be straight forward. Just follow the figure as shown.

As noted in the parts list, the Square D ground bar kits work well. The recessed sections on the side of the bars give you just enough space to make all the connections using screws that come with the kit. It is also good to get the all-metal screen door track wheels (vs the plastic ones). The plastic wheels can be slightly off center and may make your dolly wobble.

Do not over tighten the bolts to the wheels. You want the wheels to roll smoothly with low resistance.



## Pulse Width Modulation Circuit (PWM)

The PWM circuit will provide a speed control for your motor and reduce your motor speed down lower than the gearbox. It works by breaking up the current to your motor into tiny pulses. By varying the duration (or width) of those pulses, you can change the average voltage to your motor.

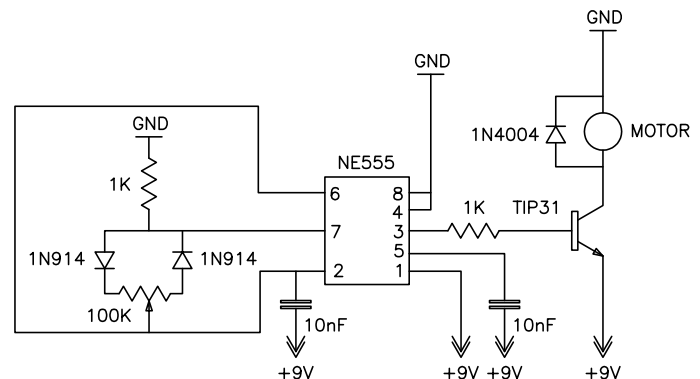
You can build your circuit in many different ways. I recommend starting on a solderless breadboard, so you can make changes if something isn't working right. Once you get it working correctly, you can make a more permanent version on multipurpose solderable PC board and put it in an enclosure. This tutorial just covers the solderless breadboard version.

Solderless breadboards allow some flexibility in constructing circuits. The figure shown here is one simple version of the PWM circuit intended for people who just want an easy diagram for hooking everything up. I have also included a schematic diagram below for those who are more comfortable with schematics.

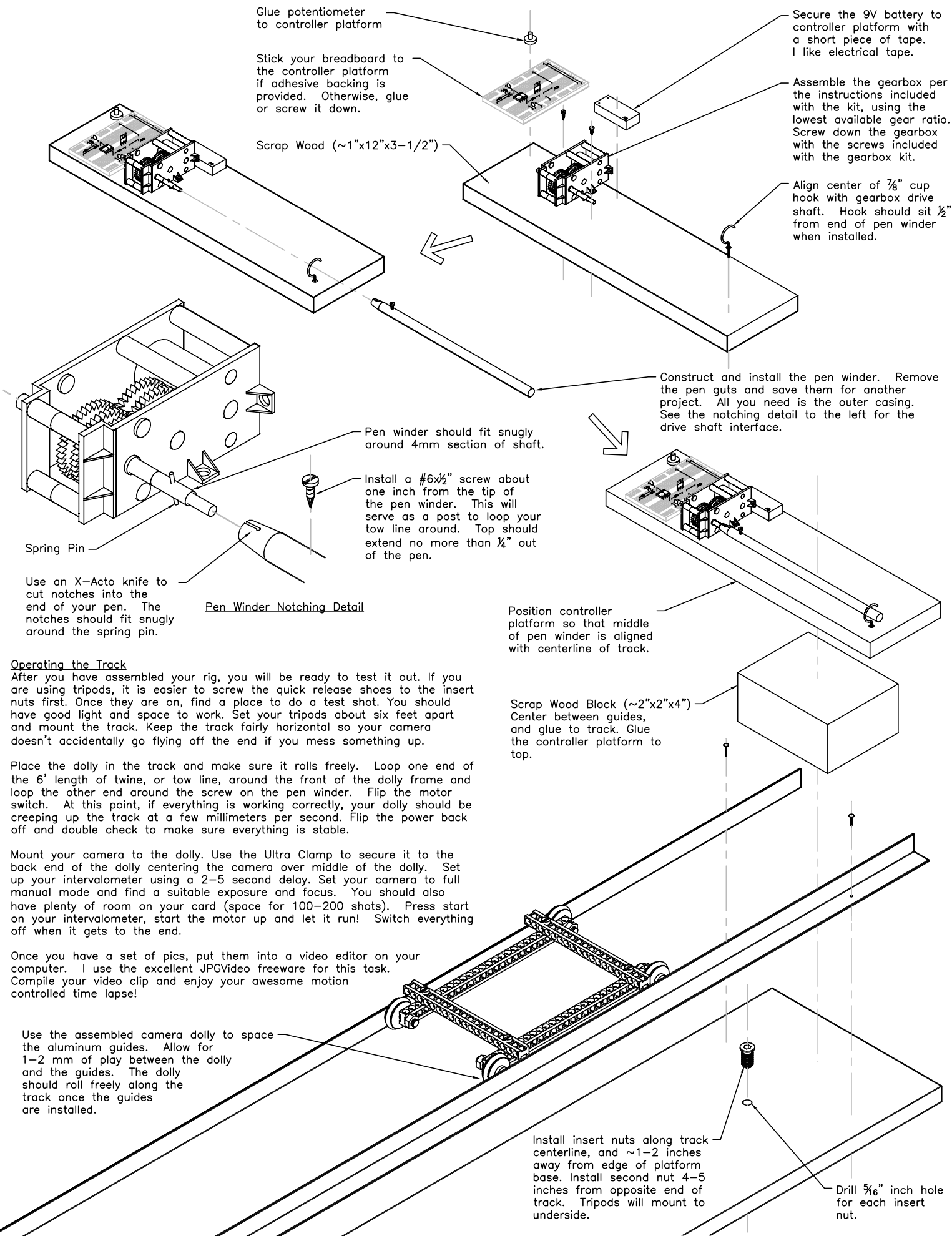
You will need to solder some short pieces of hookup wire to the toggle switch and potentiometer. Cut some 3 inch lengths of wire, strip the ends and carefully solder them to the leads on each component. You should then be able to connect them to your breadboard. Hook everything else up as shown. Install the battery last. Before you power up the circuit, check to make sure you wired everything up correctly. It may help to highlight all the connections as you do your check. If you feel good about it, connect the battery, throw the switch and see if it works. Hopefully nothing will catch fire and explode. If you see the motor running, test the potentiometer and see if the motor changes speed.

## Orienting the PWM Components Correctly

- The 555 chip should have a small half circle or circle on one end. The pins are arranged in counter clockwise order looking down from the top starting from that mark.
- The TIP31 transistor pins are arranged in the order B, C and E from left to right with the metal heat sink facing away from you.
- On the 1N4004 diode, the white stripe (cathode) should be oriented away from the TIP31 transistor.
- The two 1N914 diodes should be oriented in opposite directions relative to each other. If your potentiometer ends up reversed, switch both diodes around.
- The orientation of the resistors and capacitors is not critical. They can be installed in either direction.
- If the switch or the motor end up running backwards when you power up, just turn the power off and reverse the leads.



Building the Controller Platform and Track



Operating the Track

After you have assembled your rig, you will be ready to test it out. If you are using tripods, it is easier to screw the quick release shoes to the insert nuts first. Once they are on, find a place to do a test shot. You should have good light and space to work. Set your tripods about six feet apart and mount the track. Keep the track fairly horizontal so your camera doesn't accidentally go flying off the end if you mess something up.

Place the dolly in the track and make sure it rolls freely. Loop one end of the 6' length of twine, or tow line, around the front of the dolly frame and loop the other end around the screw on the pen winder. Flip the motor switch. At this point, if everything is working correctly, your dolly should be creeping up the track at a few millimeters per second. Flip the power back off and double check to make sure everything is stable.

Mount your camera to the dolly. Use the Ultra Clamp to secure it to the back end of the dolly centering the camera over middle of the dolly. Set up your intervalometer using a 2-5 second delay. Set your camera to full manual mode and find a suitable exposure and focus. You should also have plenty of room on your card (space for 100-200 shots). Press start on your intervalometer, start the motor up and let it run! Switch everything off when it gets to the end.

Once you have a set of pics, put them into a video editor on your computer. I use the excellent JPGVideo freeware for this task. Compile your video clip and enjoy your awesome motion controlled time lapse!