How to Enter the Ghetto Matrix (DIY Bullet Time)

by fi5e on December 19, 2007

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Intro: How to Enter the Ghetto Matrix (DIY Bullet Time)

The following is a tutorial on how to build your own cheap, portable and hood-style bullet time camera rig on the cheap and the fly. This rig was designed by the Graffiti Research Lab and director Dan the Man to use in a hip-hop music video for underground rappers Styles P , AZ and the legendary Large Professor (spinning below). Just another chapter in the GRL's continuing mission to make open source the sixth element of hip-hop.

Peep the vid at the resolution of the proletariat (below):

Or see how the higher-res live here .

Before we even get started I'd like to throw out some shout outs to PIPS:lab , Pikapika and Picasso/Man Ray for their inspiration on this project. Humbly, all the GRL did was create a tool that would enable the director Dan Melamid to remake the Matrix with Neo as a rapper from Yonkers, NY surrounded by the best graf writers in the city using a mash-up of several existing light-drawing techniques and their own hand-styles.

This project started for us when Dan called and asked if we wanted to get involved in a project combining light, graffiti, bullet time , Brooklyn, and rappers on a small budget to create a video for Styles P's *the Hardest* . Dan explained that to rent a bullet time or time slicing rig in NYC, it could cost as much as $100,000 per day. Luckily for him graffiti writers and graffiti engineers work for coffee and snickers bars. So we all worked together to make a system that only costs $5000-$8000 and takes just two days to make.

For photos of the video shoot travel here .
Big thanks to Dan for inviting us in and allowing us to open source the process in this tutorial.

(More thanks, credits, and shout outs in Step 14...)
The GRL is a F.A.T. Lab Production.

Now let's jack into the Ghetto Matrix...

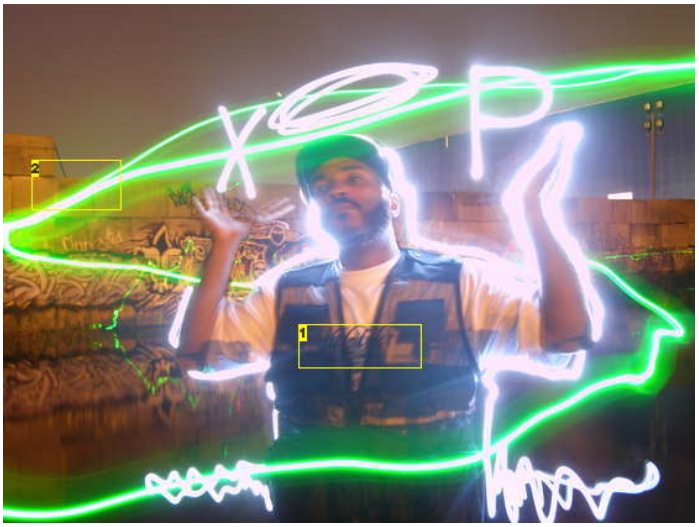


Image Notes
1. All City Crew
2. green LED throwie

Image Notes
1. the ghetto matrix in action

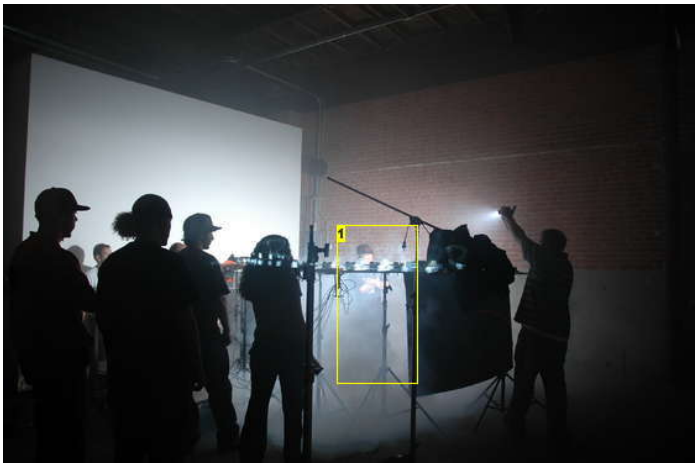


Image Notes
1. styles p

Image Notes
1. shutter release cables

step 1: Tools & Materials

The Ghetto Matrix can be divided into two main components: 1) the camera rig, and 2) camera control box.

Tools For Camera Rig:

- Jig saw
- Drill
- Crescent wrench

Materials for Camera Rig:

- (24) Digital Cameras w/ remote cable shutter control:
Olympus SP-510 UZ - $299.99 / each or less
This is not the only camera that will work and 24 is not a magic number. This is the camera that worked best for us and 24 is how many cameras we could afford on our budget. If you have more cameras you can make a larger matrix and you can place the cameras closer together. This will result in a more fluid animation covering a larger area. The most important thing you will need to check before purchasing thousands of dollars worth of cameras is that they have a remote cable shutter release . If you want to create the light effect like we did in the video, you will also need a camera that has a has a bulb setting (meaning that when the shutter is pressed it stays open until it is released). This enables you to hold the shutter open to make light drawings.

- 1/2" - 3/4" Plywood:
This will be used to create a wooden platform for the cameras. The amount of wood to complete the arc will depend on the radius of the desired system (see Step 2). Most likely (2) 8' x 4' sheets will suffice. You can find plywood at your local lumber yard and it should cost less than $40 dollars for two lower grade pieces of plywood. It aint gotta be pretty.

- (4) Compact Light Stand :
$ 53.50 / each.
We had these on hand so we used them and they worked well. Any tripod system will work however, so if you are looking to save money there are cheaper alternatives.

- (4) Steel Pipe Flange:
Make sure to get a flange with threading capable of accommodating a short pipe section (mentioned below) and at least four-hole mounting pattern. You can get this at home depot or your local hardware store in the plumbing section for ~ $3 dollars.

- (4) Steel ~2in long and ~1in O.D. Pipe Sections (threaded at atleat one end)
This Pipe section should be able to crew into the pipe flange (above). You will insert the top of the tripod stand into this pipe section to support the platform. You may need to modify the pipe section by drilling a hole into the side of the pipe opposite the thread and tap it. You can use a thumbscrew to act as a set screw on the tripod stand to make a more secure connection. You can get threaded pipe at your local hardware store or home depot for about $2 dollars.

- (24) Bolts - 1" Length, 1/4" diameter, 20 thread-count:
Most 35mm camera bodies accept a 1/4" diameter, 20 thread-count screw, but check this before going to the hardware store. These will be used to attach your camera to the wooden platform. A perhaps better alternative to bolts (which don't allow you to accurately adjust the cameras pan or tilt) would be some heavy duty velcro. This connection is strictly for stabilization purposes so it doesn't need to be anything fancy or industrial. A more flexible, but expensive way to do this is use the swivel on an exiting tripod. This will let you fully (though possibly not accurately) adjust the pan, tilt and yaw of the camera. These bolts are commonly available at your local hardware store and cost about ~$3 - $4 dollars for a box of 100.

Tools for Control Box:

- Soldering iron w/ flux and solder
- wire cutters / strippers
- Phillips head screw driver
- needle nose pliers
- drill with drill bits
- wire ties
- wire anchors
- liquid flux

Most of these tools can be found at your local hardware store or radio shack or have been sourced via online catalog companies.

Materials for Control Box:

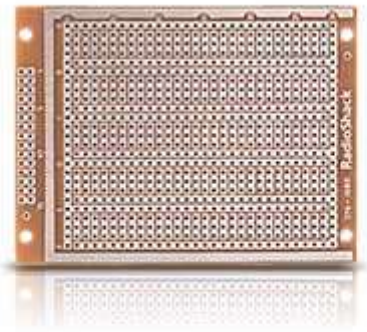
I have linked to Radio Shack component because of their omnipresence, but you can beat Radio Shack prices at Digikey , Jameco , etc.
- (3) Spools of Stranded, Insulated, 26-22 AWG Wire - $5.99
- (24) Remote Cable Release (RM-UC1) - $56.99 / each (You will need one of these per camera)
- (1) Project Enclosure (8x6x3") - $6.99
- (25) SPST High-Current Mini Toggle Switch - $2.99 each (single pull single throw will work fine)
- (1) Universal Component PC Board - $3.49
- (4) 6-Position European-Style Terminal Strip - $2.89 / each

Image Notes
1. Open up this part.
2. keep this end

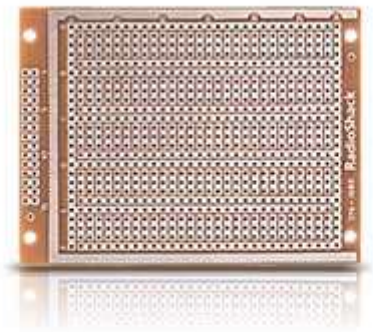
Image Notes
1. this part will fit into the pipe section thats screwed into the flange. You can tape the pipe section and use a bolt as a set screw to make it more rigid.


INSERT SCREW
AUTO
HERE


RYOBI




ON
OFF
10A 125VAC
6A 250VAC


RadioShack


WSD 81
350
Weller


SP-510 Ultra Zoom
OLYMPUS
7.1
10x
7.1 Megapixel Effective
10x Optical Zoom
Digital Image Stabilization
AA
Long battery Life

step 2: Dimension

The shape of the arc you will need to cut depends on the kind of shot and the amount of rotation around the subject you wish to achieve. As mentioned in Step 1, our plan was to create a 180 degree rotation around a subject that will be in the frame primarily from the waist up. Keep in mind when deciding on the amount of rotation you desire that at some point, some of your camera cameras will be able to see your rig in the shot (at 180 degrees for example the two end cameras will be faced directly at each other). There are ways to minimize and mask this but it is worth considering when designing your platform.

Because the focal length of camera lenses will vary it is best not cut your rig to specific pre-scripted dimensions but rather test on your cameras to find the desired shot. Have a subject stand at a distance from one of your cameras (make sure the camera is zoomed all the way out). When you have the desired framing in the lens then measure the distance of the camera to the subject. This will be the radius of your camera arc. Keep in mind that you are not limited to an arc and if you have rigging material more flexible then wood you could even reshape the rig to fit the needs of a specific shoot (see the real matrix for demonstration). We went with wood because it was cheap, fast to build, and readily available.

The radius we chose was roughly 5'. To draw the arc we took a 2x4 and drilled a hole in each end. Put sheets of plywood large enough to accommodate your rig down on the floor. In one end of the 2x4 put a pen and anchor the other end temporarily at the center point of the arc. Swing the arm around and draw a nice arc on the plywood (there are probably easier ways to do this involving wire or string). Once you have an arc drawn on the plywood get your cameras and space them evenly around the perimeter. Turn them on and see what it looks like. Put an object in the center of the cameras and adjust them so that they are all centered on the same object. Take a test shot on all the cameras. Make sure you are happy with the range of motion between frames and the proportions and position of the subject to the frame. This is one of the most important elements in getting a good shot in the end and it is one that is hard to adjust once you get the jig saw out, so get it right.

Initially, we made a smaller matrix rig, used velcro to mount the camera and had a session of shots to test the size and spacing. Afterward, we decided to expand the size of the matrix and created a larger platform and increased the spacing between the cameras.

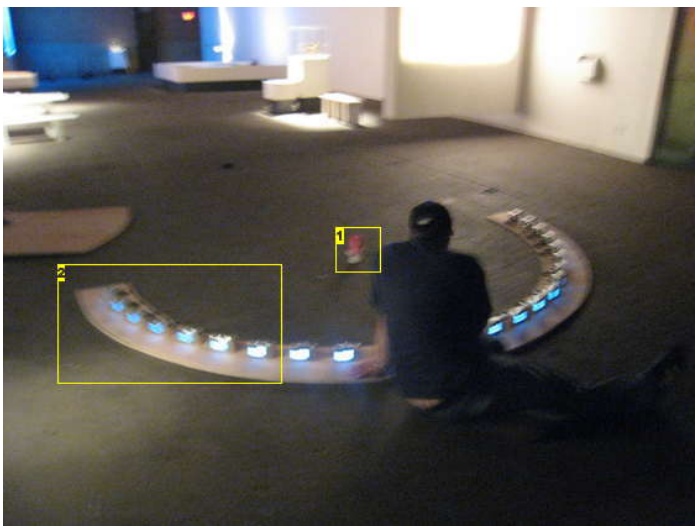


Image Notes
1. Put object in center to test and align cameras
2. first prototype using velcro

Image Notes
1. we used the lens cap to prop the camera up a bit

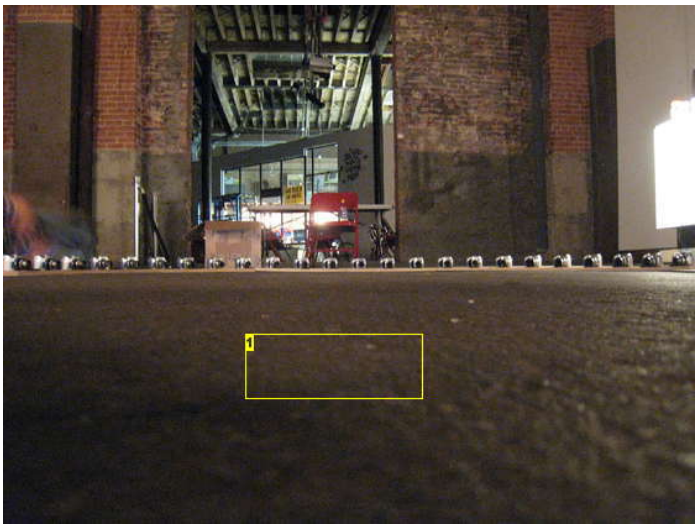
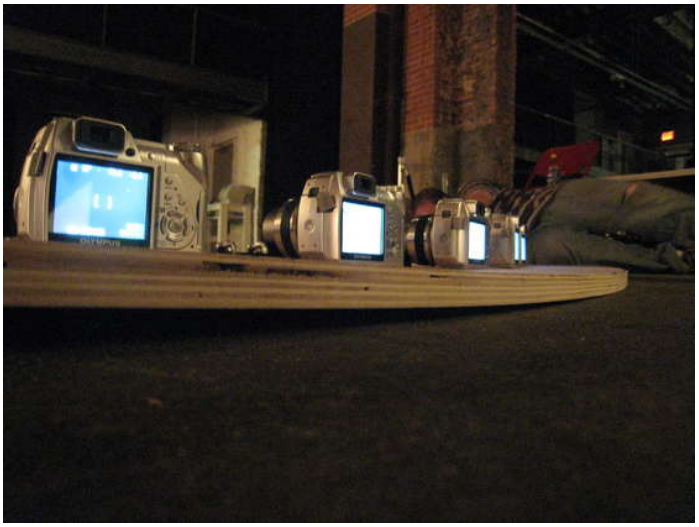


Image Notes
1. inside the matrix



step 3: Cut Wood

Once you have all of the cameras placed and spaced properly trace the camera positions w/ a magic marker directly onto the ply wood. At this point you have all the necessary guidelines drawn that you need to cut the wood. Use the jig saw to cut out the arc. Make the width of the arc deep enough to comfortably mount all of your cameras and equipment. You may need to use two pieces of plywood to create your full arc. You can connect two pieces together by "sandwiching" the two (or three if its big enough) section of the arc between two pieces of plywood and securing them with large industrial clamps. Ours was roughly 9" deep. Be careful not so set the cameras so far back that the edge of the wood shows up in the bottom of the frame.

Image Notes
1. tasty.
2. wear propa eye protection kids

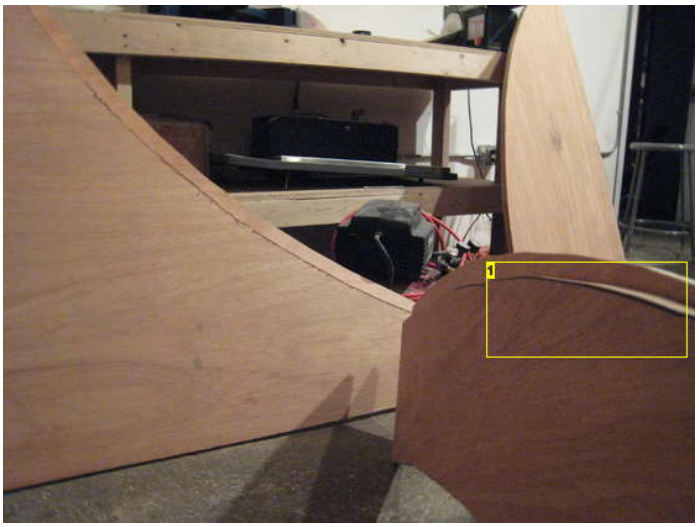


Image Notes
1. close enough for rap

step 4: Drill Holes

There are numerous ways to secure a camera to wooden surface, we used bolts. Based on the outlines you traced from the camera position, drill a hole in the location of the cameras tripod mount connection matching the width of the connection (typically 1/4"). Drill one for each camera. This is not the most accurate method for aligning the cameras, but its close enough for rap.

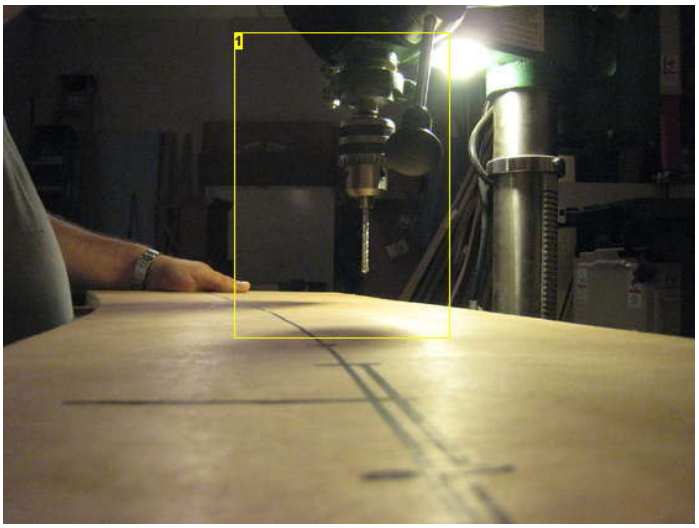


Image Notes
1. we have a drill press, but you can use a hand drill as well...

step 5: Stand Connections

You will need to come up with a system for elevating your ghetto matrix off the ground. This could be done in many ways (including chairs, saw horses, stolen police barricades, etc), although keep in mind that you are dealing with a rather odd shape (one that is not quite as simple as a table top). Because we were looking for something that would be easy to transport between sets and something that would be fast and easy to adjust height and tilt we ended up using (4) compact light stands .

To connect these stands to our wooden arc we needed to buy 4 pipe flanges and 4 short pipe sections that where threaded on one end and were the right diameter and pitch to screw into the pipe flanges and also to accommodate the top tubular portion of our light stands. The spacing on these legs is not as important as the spacing of the cameras, so when you are deciding where to mount your flanges to the bottom side of the arc make sure that they are not interfering w/ the locations you plan to put the camera bolts. We had to drill and tap the pipe section (on the end opposite the thread) so we could use a set screw (a thumbscrew actually) to preload into the portion of the light stand that fits inside the pipe section. This allowed us to make a more secure connection between the platform and the light stands. Here is a drill and tap chart that will help you decide what size drill to use in order to create a nice tap.

(see the photo notes for more details on how to do this. Its dumb simple and easy to pictorially depict)

Once you are ready, you can drill your mounting holes and screw the flanges into place. Screw in your pipe section

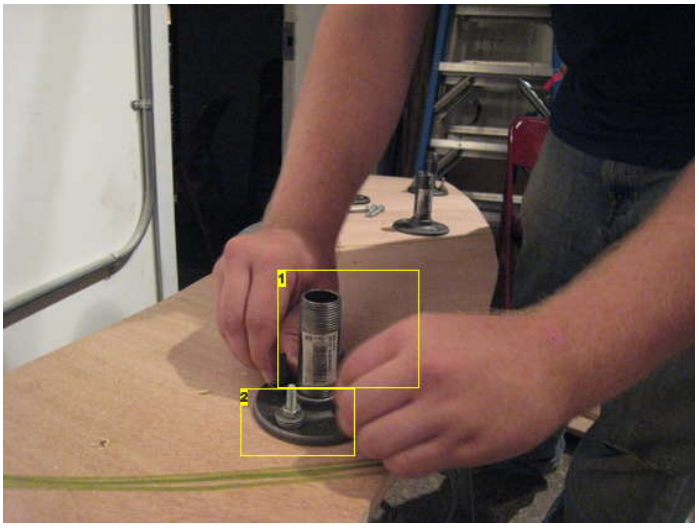


Image Notes
1. pipe section screws into flange
2. the flange

Image Notes
1. this part will fit into the pipe section thats screwed into the flange. You can tape the pipe section and use a bolt as a set screw to make it more rigid.

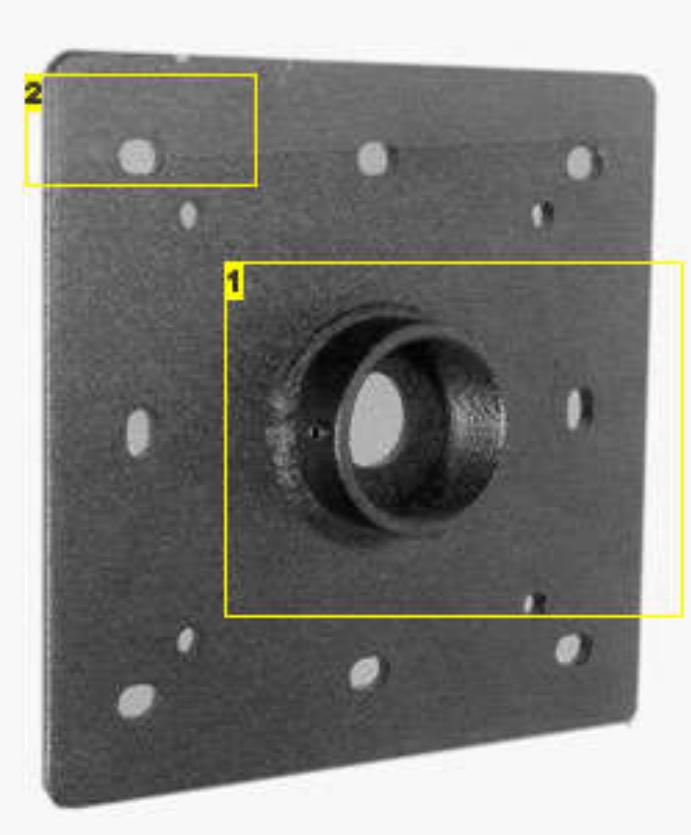


Image Notes
1. pipe flange -- the threaded pipe section screws into here
2. mount the flange to the base of the matrix arc

Image Notes
1. the light stand fits into the pipe section

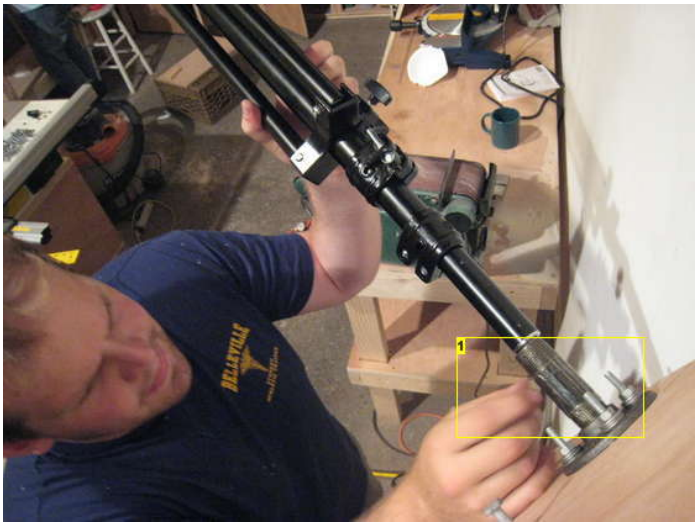


Image Notes
1. we drilled (with a cobalt drill bit) into the pipe section and tapped it for a 1/4-20. We used this bolt like a set screw to make the connection more rigid. You can make a flat section on the tube at the end of the light stand to get a better grip with the set screw.

step 6: Shutter Cable Hack

The next step is control. We need to be able to fire all the cameras at the same time and control each one individually. Luckily, the Olympus SP-510 UZ was chosen in part because it has an optional external shutter release cable that allows you to trigger the shutter, hold it open and close it all through the USB port. But to make this cable work in the matrix you need to:

1. hack the cable
2. extend the length of the cable

To Hack the Cable:
Open the the plastic casing on the remote cable release with a small phillips screwdriver. You will see three spring steel metal "fingers" stacked above one another with a small offset between each one. These fingers are conductive. Each finger has a single conductor connected to it. When you presh the button a plastic feature applies a pre-load on the spring fingers, which in turn bend to touch one another in series; First the top finger touches the middle, then the middle and top fingers both make a connection with the lowest finger. This action corresponds to three states of action in the camera: (1)Open circuit -- when the fingers are not touching, the camera is asleep (or awake if you recently took a photo, but the camera is inactive); (2) Half-trigger -- when you partially depress the button, the top finger touches the middle one and triggers the half-release mode; (this allows you to trigger auto-focus or wake the cameras from sleep without taking a photo) and (3) when you fully depress the switch you open the shutter and begin taking a flick. When you release the button the shutter closes and the camera is ready for another photo.

so this means:

- *The top conductor is the half-trigger control wire.*
- the middle conductor is power (a multimeter confirms).
- The bottom conductor is full-trigger control wire (i.e. take a photo dog!).

Now label those conductors and cut cut em. You can toss the plastic housing right in the landfill. Don't cut the small usb connector on the opposite end of the cable. We need that.

For our purposes we can connect the half-trigger and the full-trigger release leads together.
We will control the camera by "pulling up" the half/full trigger wire(s) to the power bus (which is 5VDC provided by the USB port of the camera).

You can still use the half-trigger function by quickly closing and opening the circuit from the control box. There is a ~1 second lag between flipping a switch on the control box and the actual triggering of the camera.
(see drawing below for more detail on the inside of the cable release housing.)

Extend the Cable:

I used a 24 AWG twisted pair of stranded conductors in a single insulated cable for each camera.

To solder this together I used:
- a Weller soldering iron a
- wire stripper
- wire cutter
- pliers
- solder
- liquid flux
- shrink tube
- electrical tape
- wire ties

These parts all commonly available in a hardware store or a radio shack (see materials list in step 1 for links).

This next part of a pain in the ass (cuz the insulation on most consumer equipment is cheap and not heat resistant and the conductor are typically small):

1. strip the half trigger and full trigger leads
2. twist the the half trigger and full trigger conductors together, flux and solder them.
3. solder the half/full trigger bundle to the one of the twisted conductors.
4. strip, tin and solder the power lead to the other twisted conductor in the cable
5. Use shrink tube and tape to add strain release on both wires. Use wire ties to create a "service loop" for strain release.
6. cut back the cable insulation and expose the two conductors on the opposite side of the cable. You can strip the wires as they will need to fit into a screw-down terminals.
7. Repeat for N number of cameras. This gets real old real fast.

ON the other end of the cable you will have two leads: camera control (thats the half/full trigger bundle we soldered together) and camera power. I soldered all the camera power leads together in a big solder ball, with a single wire jumper i could plug into the box, the i covered it all with electrical tape. Bad form right, but i had some people breathing over my shoulder. The camera control leads will plug into the control box and the screw-down terminals. Label these cables with tape and a sharpie now and save yourself a little grief.

Image Notes
1. Open up this part.
2. keep this end

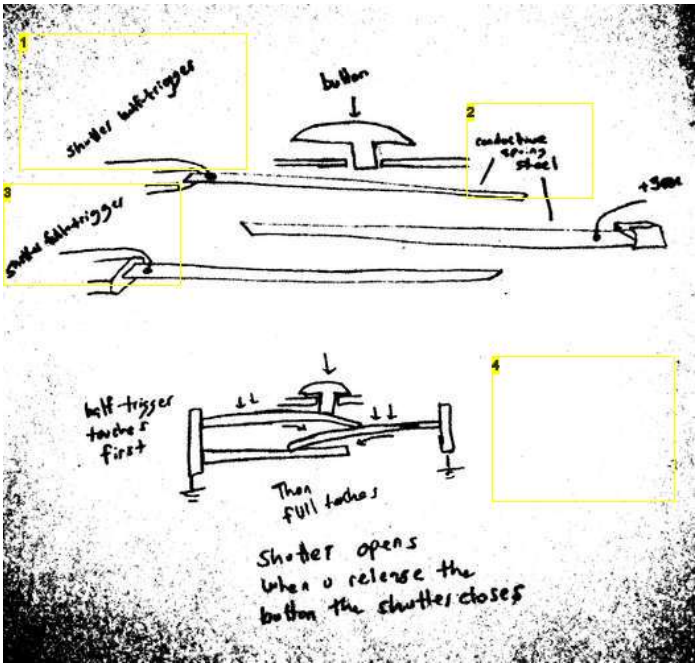


Image Notes
1. shutter half-trigger
2. conductive spring steel
3. shutter full-trigger
4. the fingers bend and touch each other in series to close the circuit. The design is to mechanically allow you to have three states: open circuit, half-trigger and full trigger.

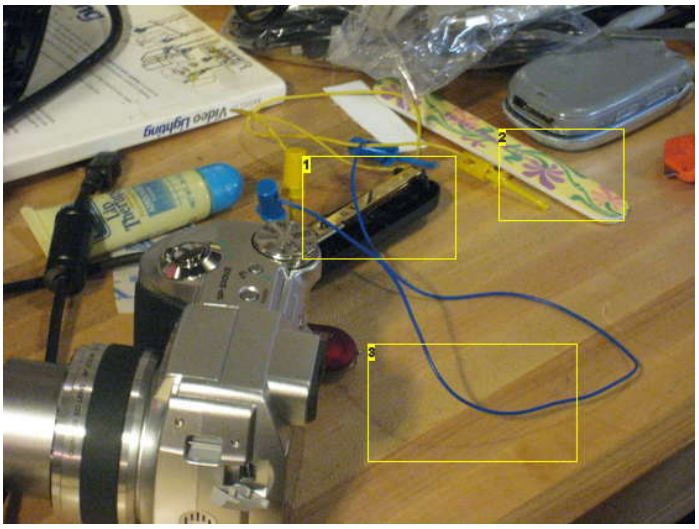


Image Notes
1. Inside of shutter remote.
2. For keeping dem nails looking niiiiiice.
3. sorry for not having a decent flick of this

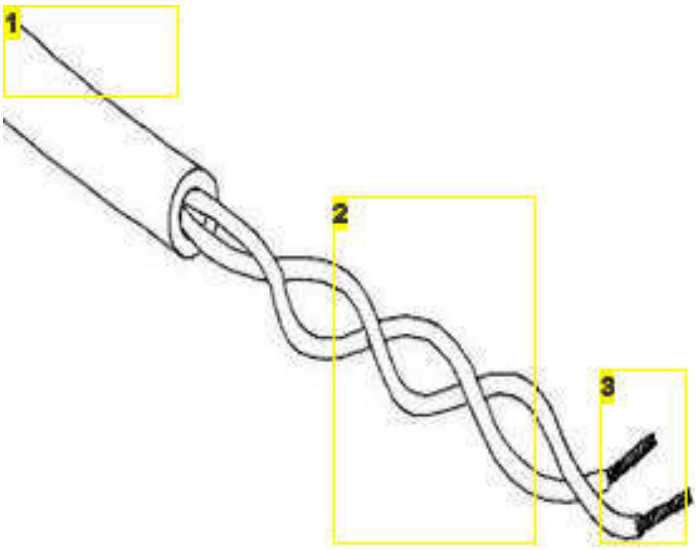


Image Notes
1. insulation
2. twisted pair of conductors
3. exposed leads

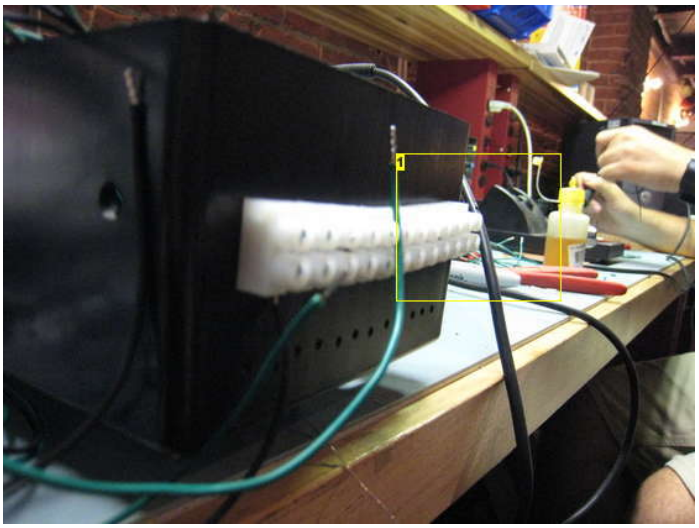


Image Notes
1. connect control cables here

step 7: the Control Box

Now to make the brain of the matrix. Its real simple like a dinosaurs brain but needs to be pretty robust if you are going to take it in the field.

The control box will have a grid of switches, one for each camera. It will also have 1 master switch to rule them all. In most scenarios you will have the individual camera switches in the on position, and then toggle the master switch on and off to take photos. Putting a switch on each camera makes it easier to debugging problems and can be used in a number of new ways to create content.... and it makes your control box look really... intense. In addition to the switches, the control box will need two kinds of terminals that will allow you to quickly plug in the camera cables.

To make the box you will need:
- a drill
- a soldering iron
- solder
- liquid flux
- (25) SPST switches
- (2) power terminals
- (4) 6 channel screw down terminal blocks
- a large plastic enclosure
- stranded wire 24 AWG
- wire ties
- wire anchors
- tape

These parts can be found in your local hardware store or radio shack. See Materials List in Step 1 for links to parts.

(see the scan of a hand-drawn [.:.:.] schematic for the detailed circuit and control logic table in the images below)

Step 1:
Drill all of the holes needed in the box to mount the switches. We used 4 rows of 6 switches on the top face of the enclosure, and one master on the front side. We mounted two 6 channel terminal blocks on each side of the box (for a total of 24). To feed the connections from the terminal blocks to the switches we drilled 12 small holes on each side of the box. Finally we drilled two large holes on the side of the box for the power terminals.

Step 2:
Mount the switches using the mounting hardware they come with, including the master switch. Use the washer they provide with the switch and drill a very small hole to utilize the small tab on the washer. This will keep the orientation of the switch consistent so you know what's up from down.

Step 3:
Mount 2 terminals on each side of the enclosure, using the self-tapping screws provided. You can screw them directly into the plastic. Drill a small hole above each terminal for you to pass conductor inside the enclosure.

Step 4:
Solder a stranded wire to one contact on each SPST switch, then feed the other end of the wire through the corresponding hole leading to the terminal blocks. Cut the wire to length, strip it and screw it into each channel of the screw down terminal blocks on the side of the enclosure (See photo below).

Step 5:
Solder a stranded wire to other contact on each SPST switch, then solder the other end of the wire to a single continuous bus (camera control bus) on the component or perf board. You are connecting all the of the control cables from the camera together.

Step 6:
Solder a wire on one contact of the master switch. The other end of this wire can be connected to the camera control bus on the perf board. Solder 2 wires to the other contact on the SPST and the solder (or attach via terminals) the wires to both of the two power terminals on each side of the enclosure. You can mount you perf board on the lid of the enclosure or just cram it into the box. You already know which one we did.

Step 7:
At this point your brains should be online and ready to go. Label the terminals and each switch with a label maker, tape + a sharpee or a paint pen.

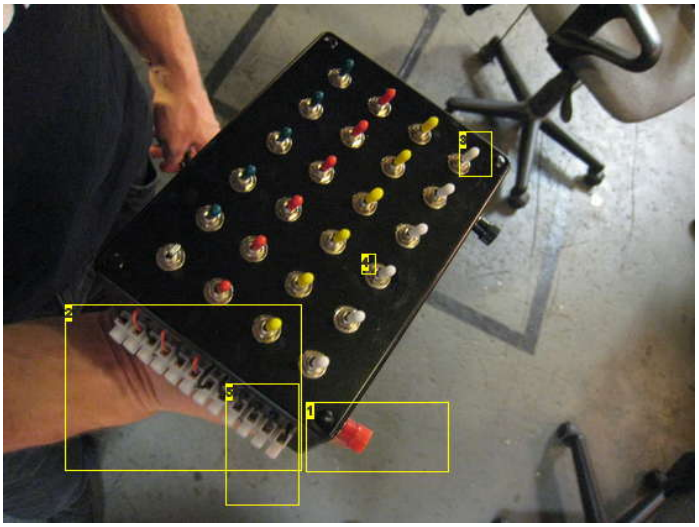


Image Notes
1. terminal for attaching +5 VDC powder channel of the camera cables
2. screw down terminal blocks for inputing camera cable control channels 0-11 on this side 12-23 on the other
3. these are literally from a radio shack in the ghetto
4. the washer that comes with the switches has a small tab that will fit into a very small blind hole you should drill into the enclosure. This feature will keep the switch pointing in the right direction. You have to know up from the down. The switches must be rigidly held in the box.
5. the screw terminal are the feed through variety, so you connect your cables from the camera to the bottom terminals. you run a lead from the top terminals through holes drilled into the enclosure and to the switches.

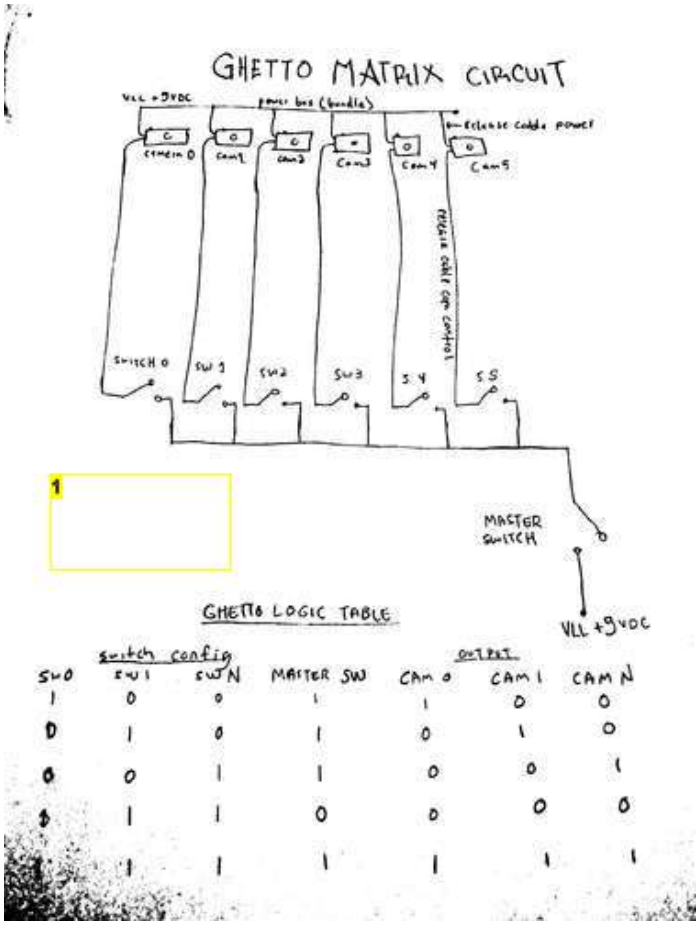


Image Notes
1. OPEN THIS AND ZOOM in a photo editor and you can read it. its dumb simple but works

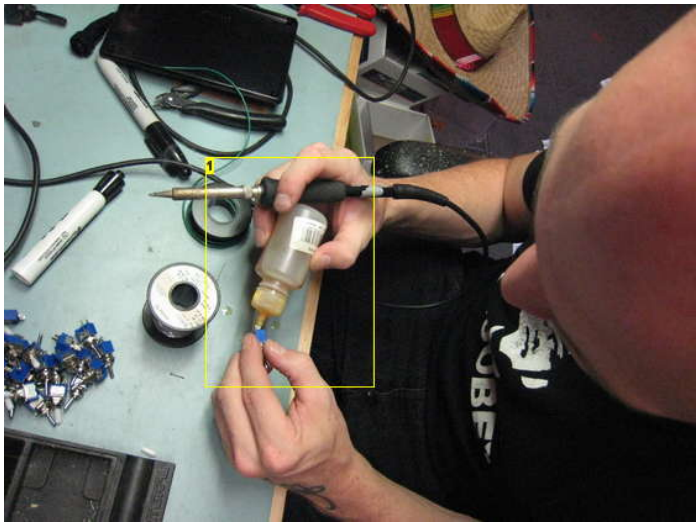
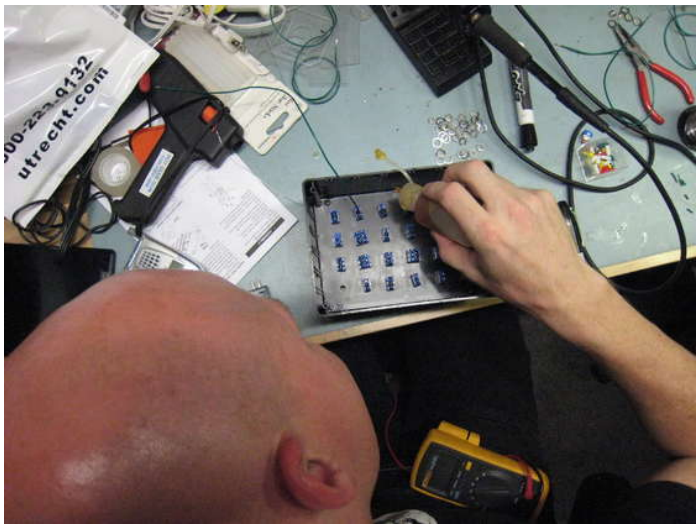


Image Notes
1. Im fin to get my solder on so you know i got my liquid flux



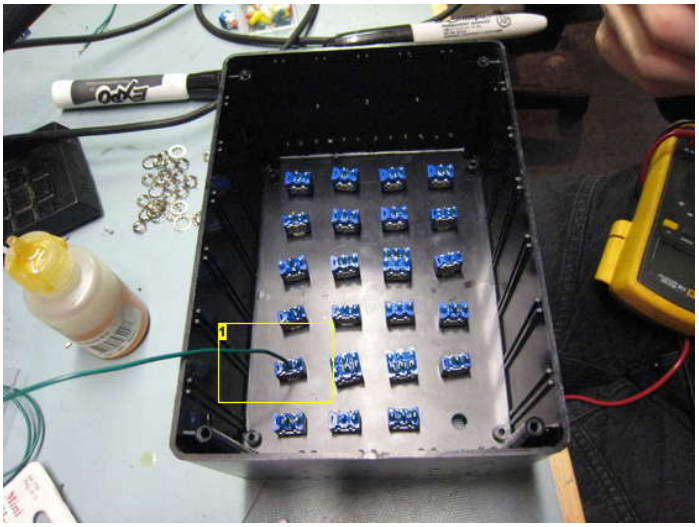


Image Notes
1. lead connects the switch to the common control bus on the perf board or component board

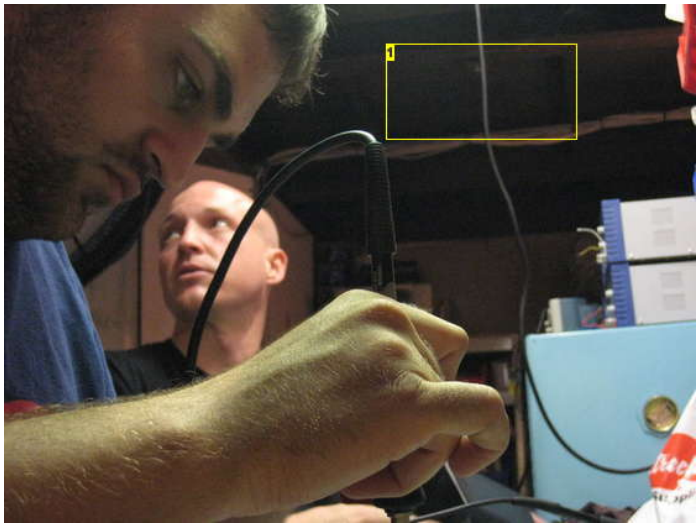


Image Notes
1. That's Nate Nasty on the iron

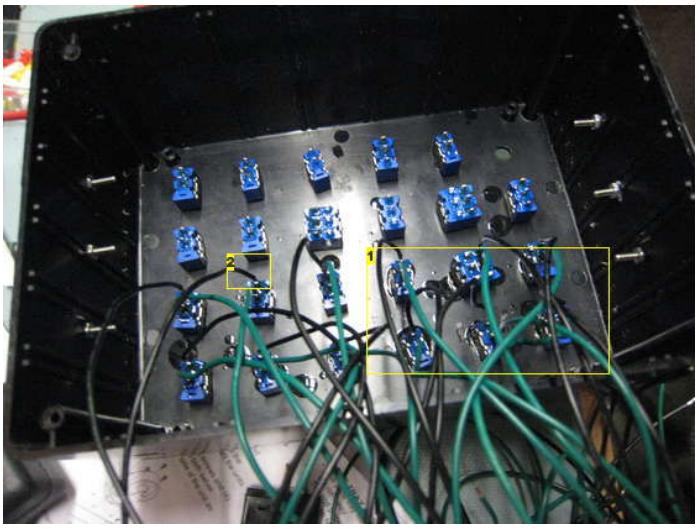


Image Notes
1. this get more complicated as you go down cuz the workspace get smaller and your hand has to get more baroque to reach the contacts. You could just measure the wire lengths and then solder these outside the box. i like to do it the hard way.
2. control lead from terminal blocks to switch

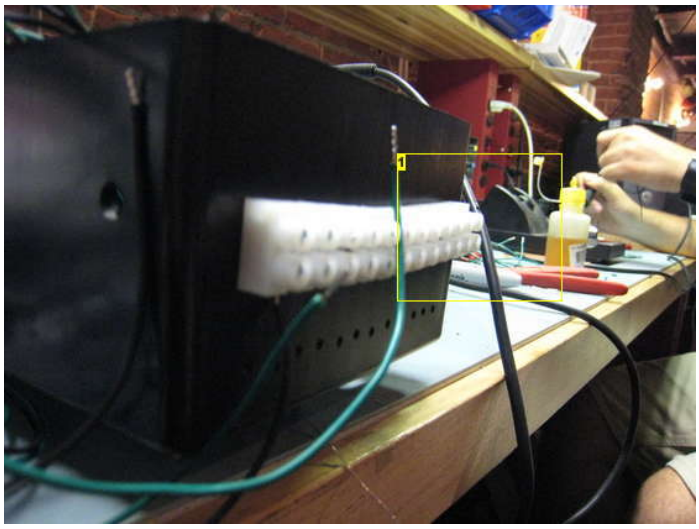
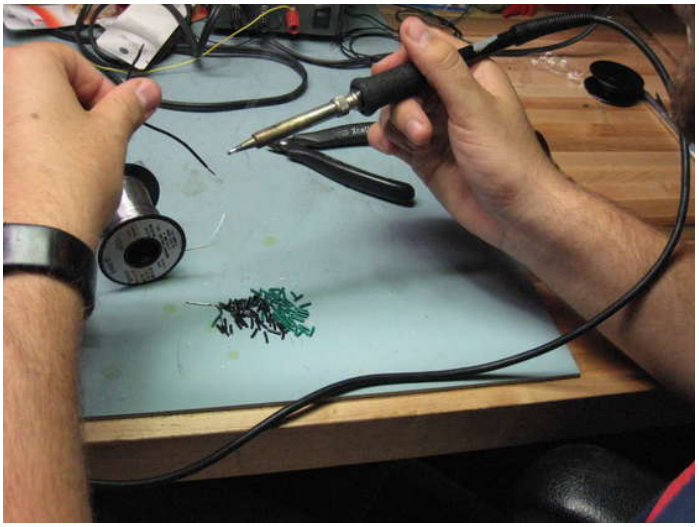


Image Notes
1. connect control cables here



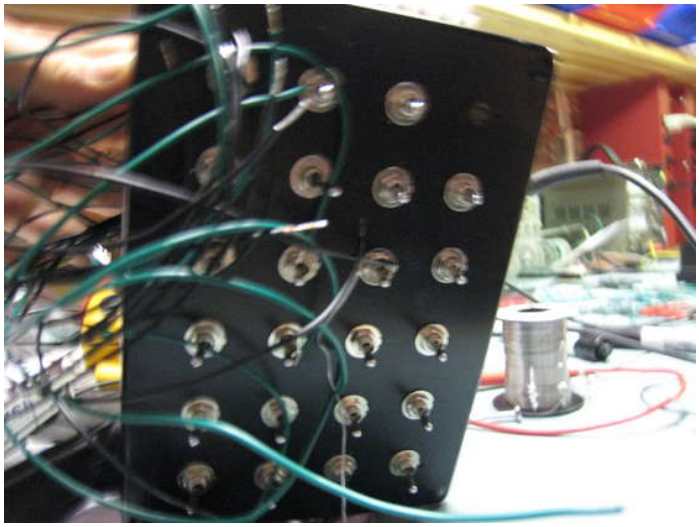


Image Notes
1. ridin durty

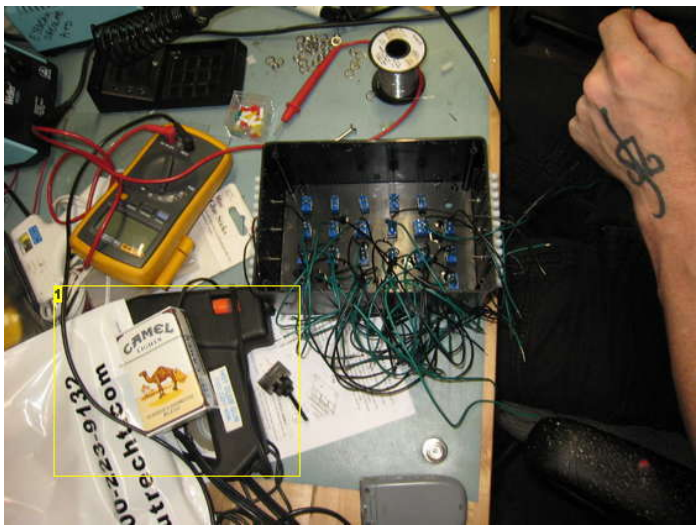


Image Notes
1. stay away from these kids!

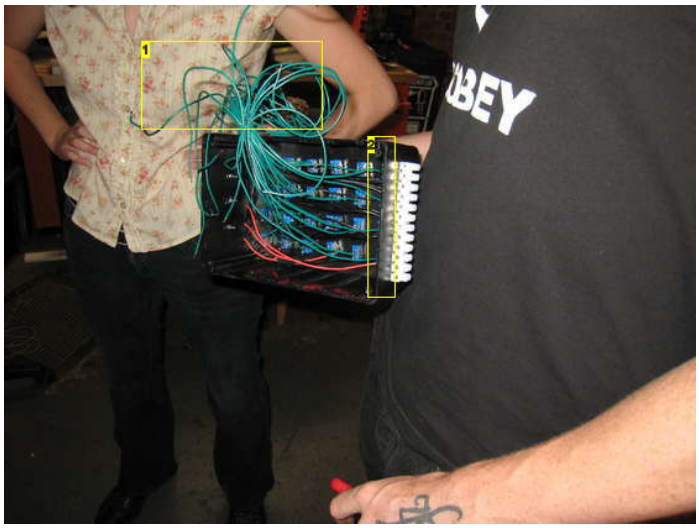
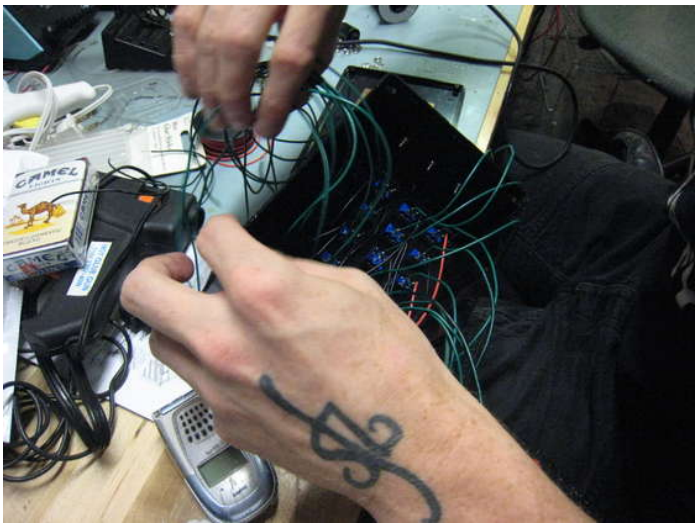


Image Notes
1. control leads ready to solder to perf board
2. black and the three read cables connect the switch to the terminal blocks



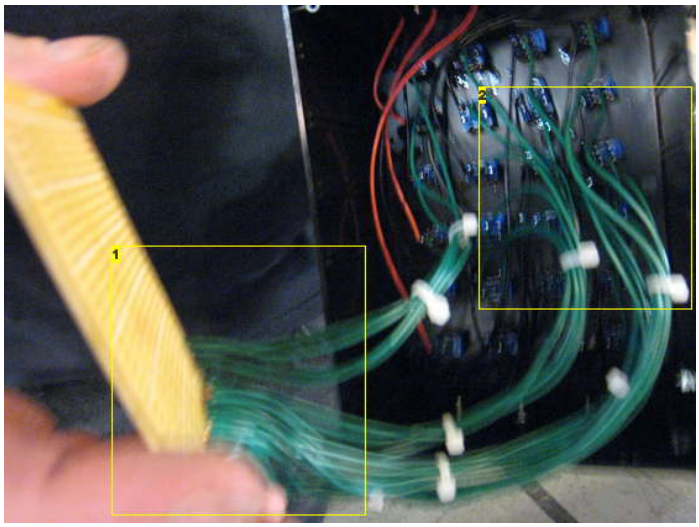


Image Notes
1. connect all the outputs from the switches together so you can make a master switch.
2. control leads

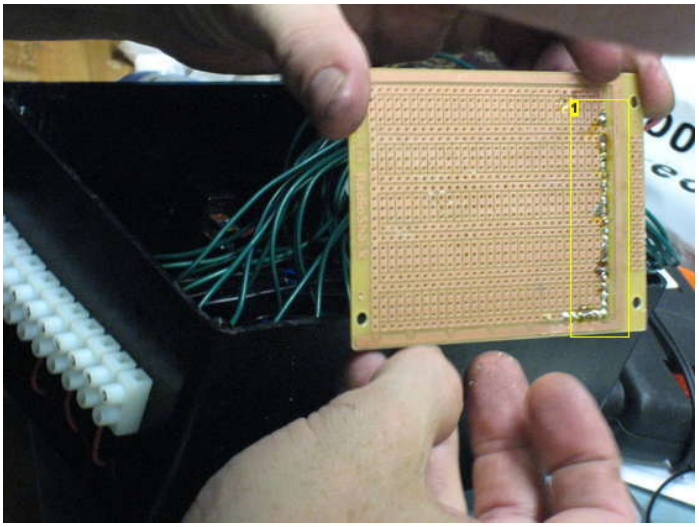


Image Notes
1. common control bus. this allows you to make a master switch

step 8: Setting Up the Rig

At this point it's just a matter of setting it all up. Once you have a location picked out just screw the light stands into the platform. Screw down the cameras. A level is helpful in order to get the entire system even, however, in the end as long as it looks good through the view finders you are ok. Repeat the same steps you used when first positioning the cameras: put a person or object at the position where the action will be taking place, and adjust the pan and height of the cameras as needed. Look through the cameras at the end of the arc and determine how much of the rig is visible in the frame. To avoid seeing the actual rig in the shot cut a black sheet that will cover the rig from the top to the floor. Tape the sheet to the rig and pull it over the cameras letting it hang down to the floor. Cut holes for every camera you intend to cover and pull the lenses through. Make sure you are not covering any auto-focusing elements of the cameras if you plan to use auto-focus (See photos below).

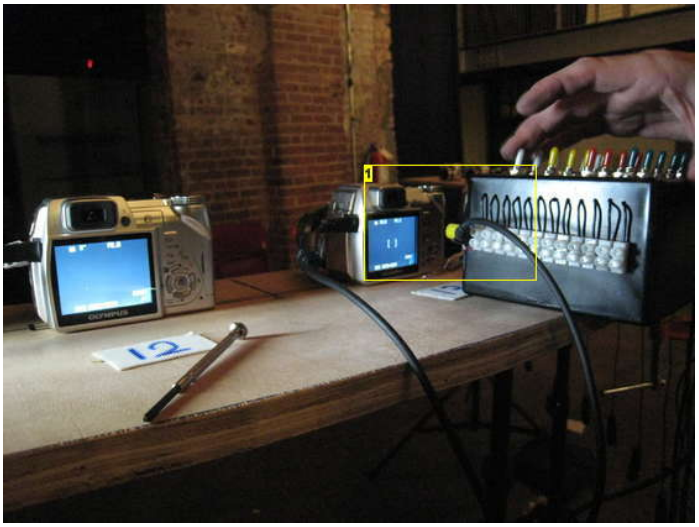


Image Notes
1. first test with a single camera connected

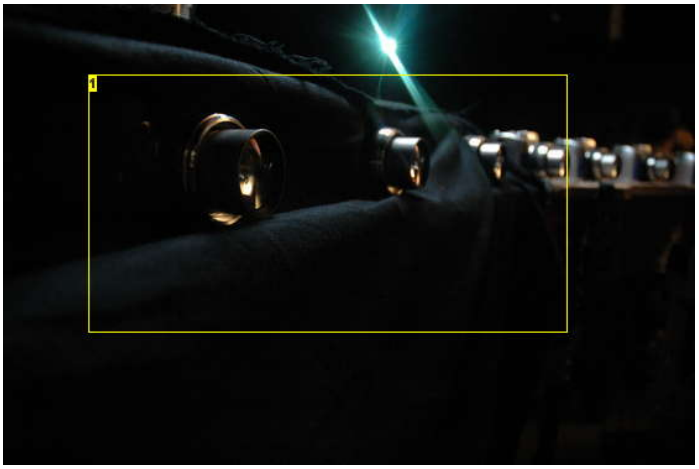


Image Notes
1. sheet to mask the camera from seeing itself at 180 degrees

Image Notes
1. yes he was

Image Notes
1. labeled son

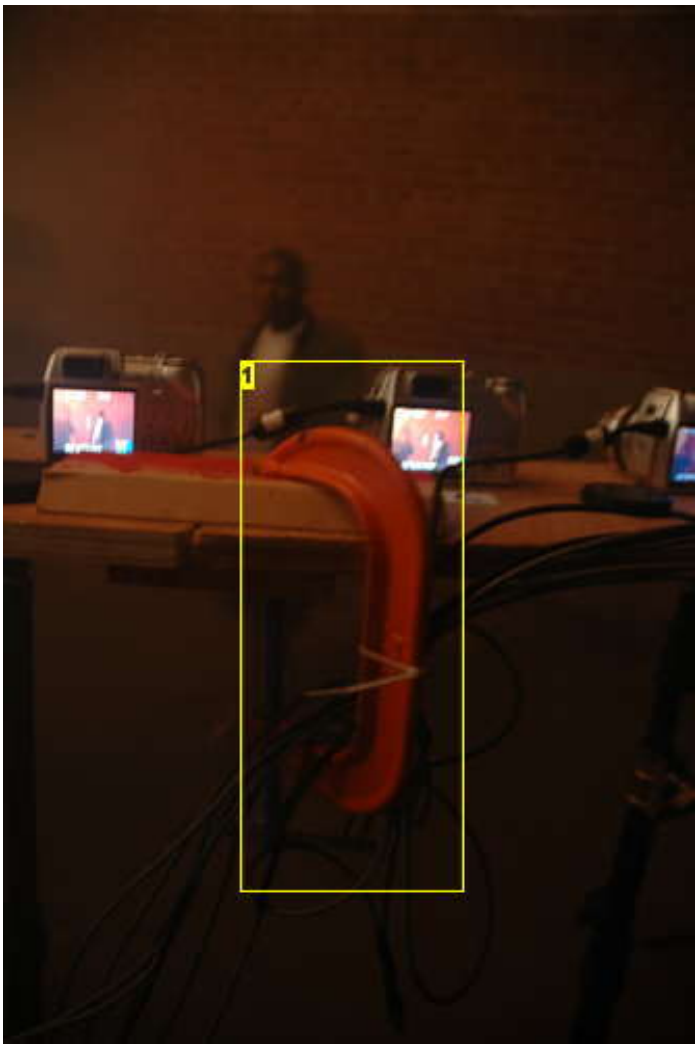
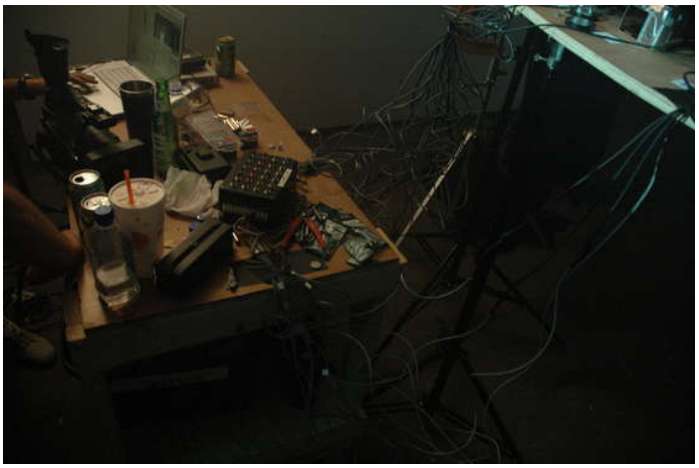


Image Notes
1. we connected the two halves of the rig together with a big ass clamp

Image Notes
1. throwie spray can

step 9: Connecting All the Cameras

Make sure the cameras are loaded up with empty SD cards and if possible manually set the camera to start numbering files from 0. This will help tremendously in the editing process when you are trying to piece all the footage back together. Check the settings on the cameras to ensure that they are all powered on, set to bulb, w/ no zoom, and all have the same settings (eg. ISO, exposure, etc.). Plug in all of the remote cable releases into the corresponding cameras via the usb connector and attach the camera release cables to the control box. First connect the camera control conductor from each cable to the corresponding screw-down terminal. Make sure when you are making the cables to use a label maker or tape and a sharpee to label each cable and the screw-down terminal blocks if you intend to trigger each camera separately. Next attach the power bundle from all the release cables to the power connector on the control box. Test the system by quickly triggering all the cameras to wake them up and take a photo with each camera individually to make sure they are connected in order and properly functioning. Check each camera to make sure it is in the correct mode and has the proper bulb and lighting settings.



step 10: Pick Your Spot!

Don't be chained to your studio. Go outside and play. One advantage of the Ghetto Matrix is that it is portable and quick to set up. We were able to sneak the entire system through holes in fences and onto government property to do entire shoots in less then an hour without anybody knowing. Take advantage of this portability to find interesting and new locations. If you didn't climb a fence you didn't do an honest days work. This is something the Non-Ghetto Matrix can't do, so exploit it. If you plan to create light drawings you need to find a spot with low ambient light.

Image Notes
1. REDHOOK!

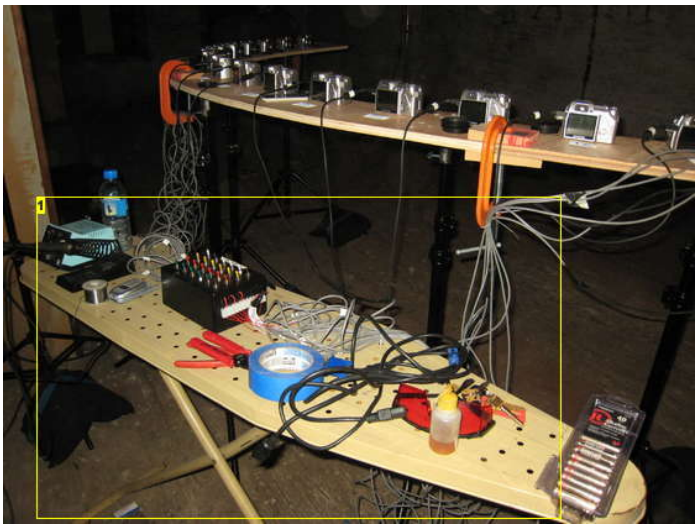


Image Notes
1. ironing board control table

step 11: Ghetto Matrix Operations Quick-Start Guide

Because we were experimenting with open shutter photography ambient lighting was kept to a minimum. Operationally, we used the camera as follows:

Step 1:
Get everything set in place (eg. subject is on the mark, camera trigger person is ready, and graf writers are standing by with light writing implements).

Step 2:
Turn off all of the lights so that it is as close to pitch black as possible. The person on the Ghettro Matrix control box gives a count down to zero and then opens the master switch so that the shutters on all of the cameras open.

Step 3:
The subject (aka person on film you want to see) stands very still in the dark as the people doing the light writing draw imagery and trace the subject using anything ranging from LED Throwies to flashlights.

NOTE: LED Throwie Mod #374
Most of the writing done in our shoot was done with a modified LED Throwie . Make a Throwie and leave one of the LED legs loose (by putting tape underneath the leg creating an offset, but leaving an exposed area on the battery contact surface under the raised LED leg) so that when pinched the LED turns on. You can easily craft something that works using electrical tape. This allows the graffiti writers to quickly and easily turn the LED on and off when writing.

Step 4:
Once the graffiti writers have completed writing they quickly exit the frame and yell "we out hackers".

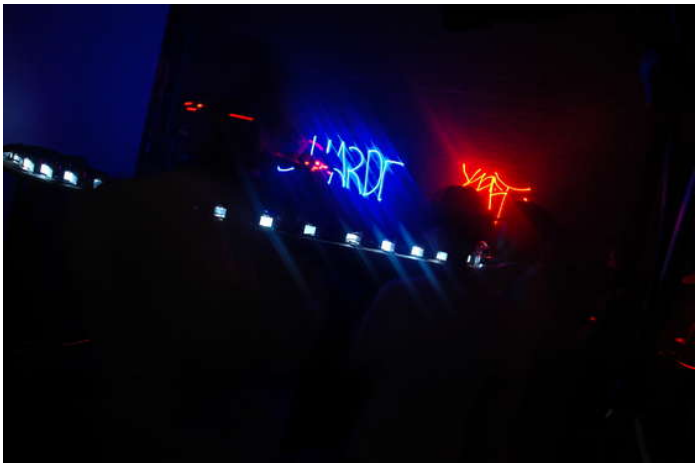
Step 5:
Before the camera shutters are closed the subject is hit with a single flash from a strobe or camera flash, exposing the subject. If you want to emphasize the light writing instead of the people then minimize or skip the flash all together.

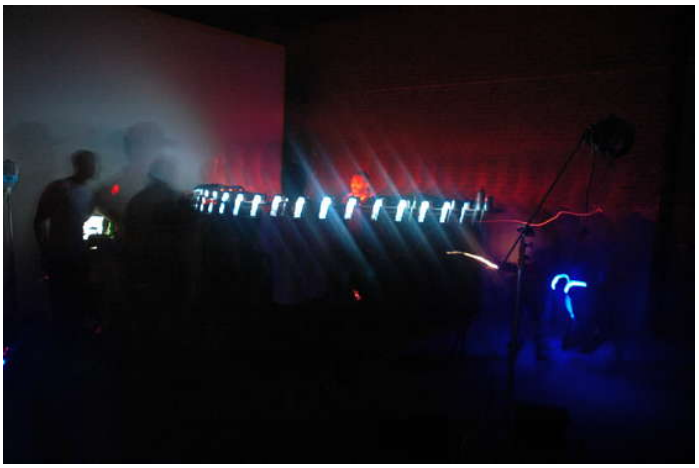
Step 6:
Flip the switch on the control box closing all of the camera shutters. The entire process from Step 2 to Step 6 should only take about 5 - 20 seconds (depending on the amount of ambient light and desired result).

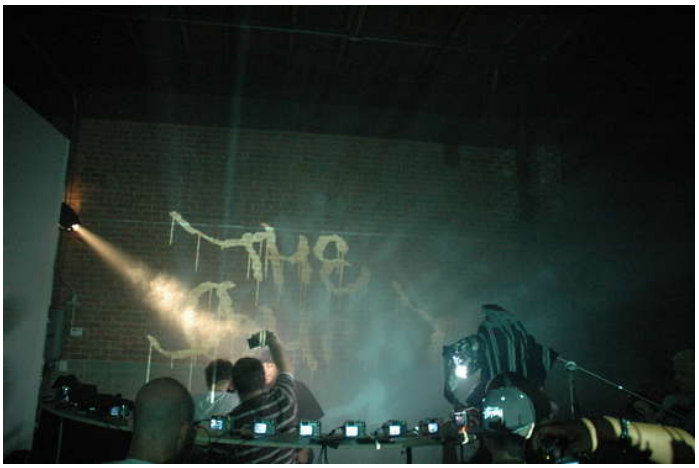
Step 7:
Look at camera display of resulting shot. Based on the preview image you should be able to adjust the writing, exposure time, subject position, and lighting quickly and re-shoot.

Step 8:
Repeat till dope!

Image Notes
1. you gotta stunt in the matrix







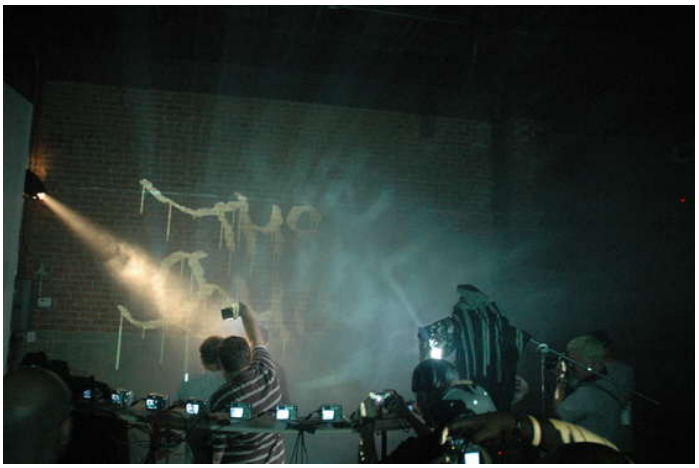
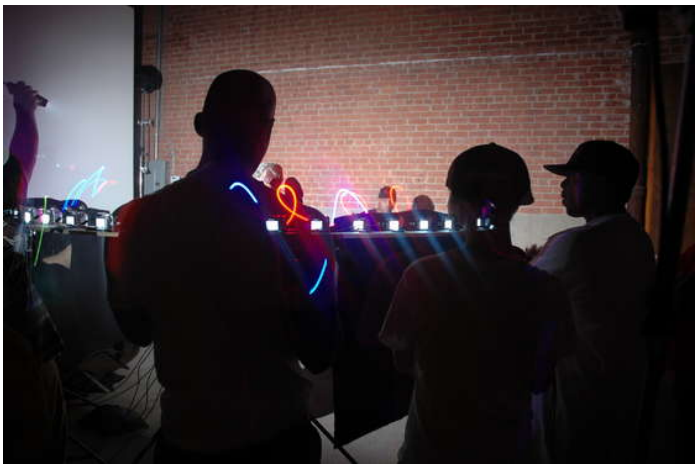
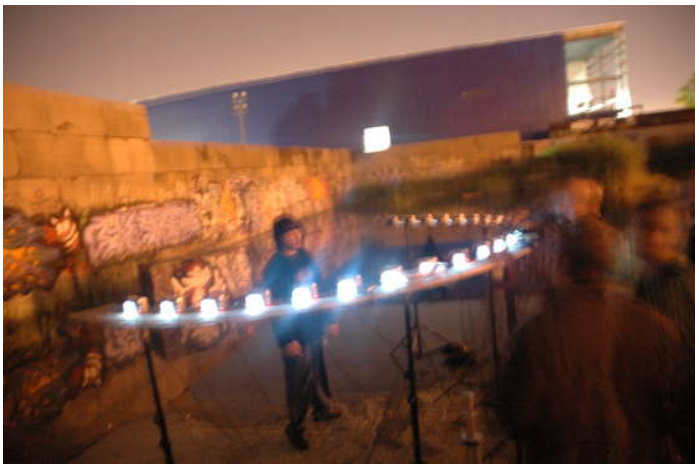


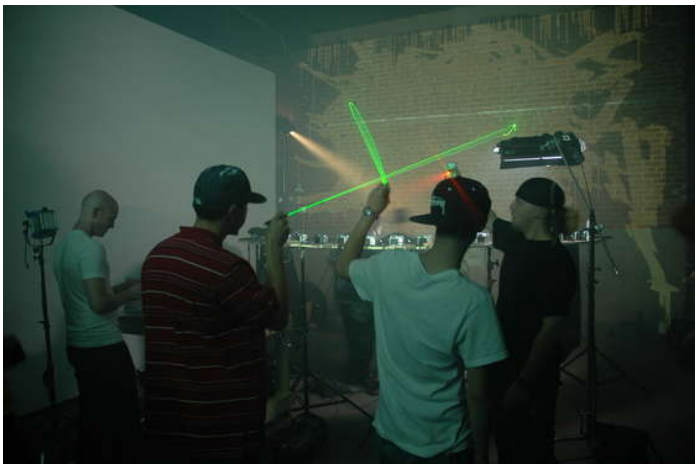
Image Notes
1. yea yea!

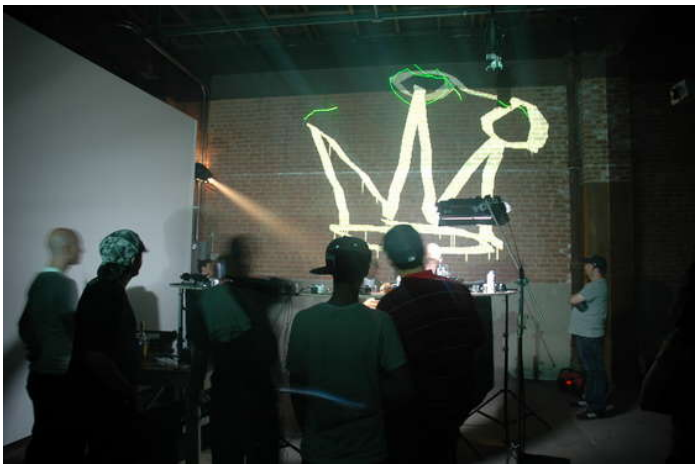


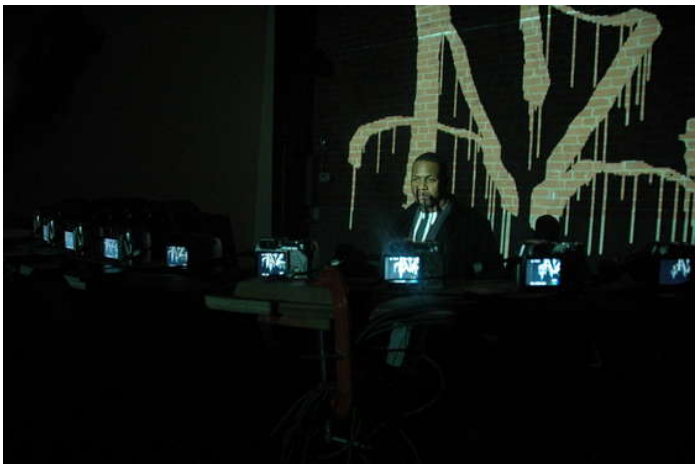


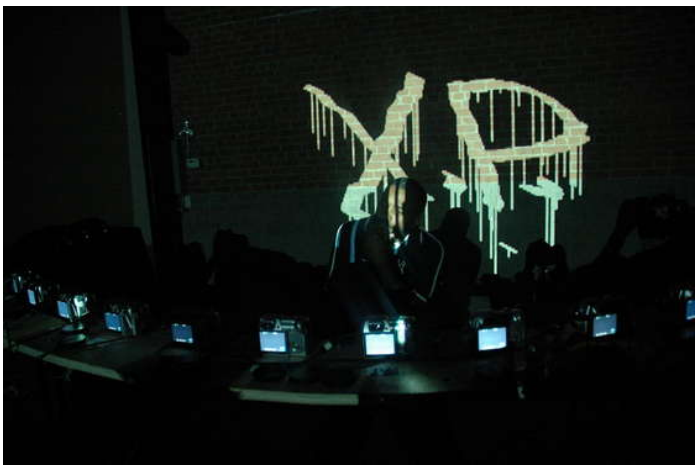
step 12: Act a Fool Son!

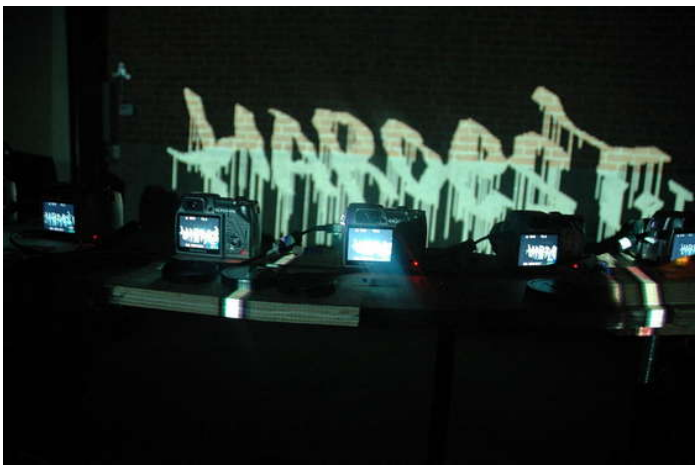
You know what to do. Just relax and let nature take its course. Because we were just shooting photos (and not using memory intensive video) we just keep shooting till the SD cards filled up or the camera batteries ran out. The only reason not to shoot a ton of footage is to save yourself some time in the post production process, but it is always a good rule to shoot more then to shoot less. Experiment with positioning the subject at different distances to the camera rig and with leaving the shutter open for varying amounts of time. It's a good idea to preview all of your shots in the camera view finders as you are shooting so that there are no surprises once you begin editing the footage. Light drawing is just one way to use the Ghetto Matrix. With the controller you can trigger each camera separately and play around with time lapse in 3D, record live video from all angles, use the flash to catch high-speed 180 action... By hacking the controller cable and combining it with an A/V out cable and a usb download cable to create a system where you could preview the frame using the A/V out into a monitor (and record it) and/or connect the camera to a computer, what called tethering, so you shoot directly to the hard drive or use an automated script (or existing software) to download the contents from each camera after a photo is taken. In this way the whole process could be automated. I don't know the limitations of multiple camera tethering via USB hubs and could find little info on it, but someone out there in the internetz does. Make it so hacker. Our next experiments will be in creating a modular rig that can be combined to create different shapes.

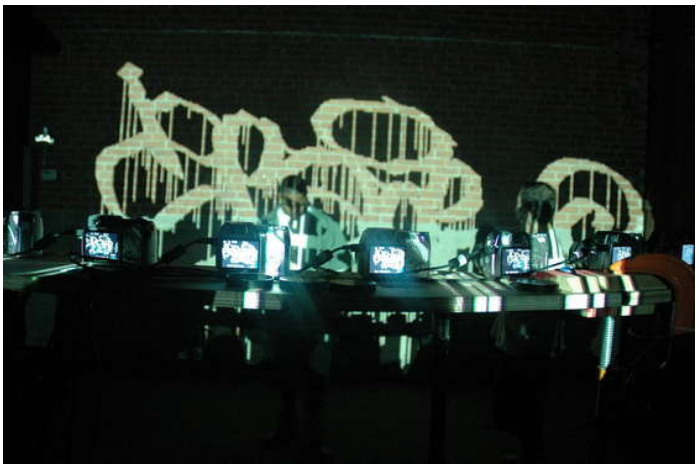


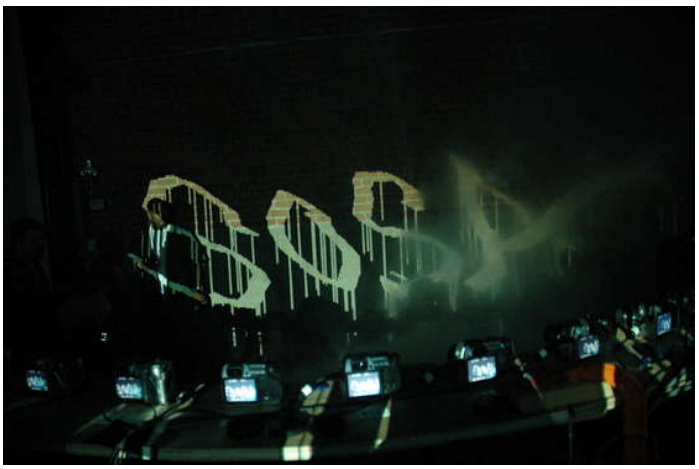








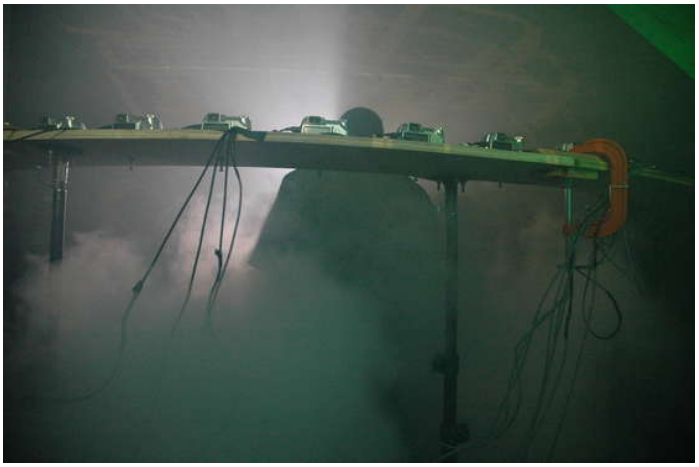





FUCK


NIKO!


Hip Hop



step 13: Post Production

I'm no expert in post production work, so there might be better ways of doing this. Below are the steps I took for combining all the individual frames into an animation:

Step 1:
Dump all of the footage from your cameras SD cards onto your HD. If the frames are all named properly you should be able to easily group them into folders. Be careful not to overwrite files with matching names. Once you have identified which shot you want to animate find all of the images and put them into one folder (renaming files as necessary). You should have one image per camera.

Step 2:
Launch Premiere and start a new project (other video editing programs such as Final Cut Pro will work similarly, we aren't doing anything fancy here). In the end I am going to create a 640 x 480 video, but it is a good idea to work at a slightly higher resolution in order to have some room around the edges of the shot to account for differences in camera angles. Set the width and height of the new project to 800 x 600, 30 fps, square pixels.

Step 3:
Go to Edit -> Preferences -> General. Change the value *Still Image Default Duration* to 5 frames. This will set every image equal to 5 frames in length upon import.

Step 4:
Go to File -> Import and select all of the images in the sequence.

Step 5:
Drag all of the image from the Project resource list into the timeline. Because the images are still at full resolution we will need to match them to the 800x600 dimensions of our project. Select all of the clips in the timeline. Right click anywhere in the selection and go to *Scale To Frame Size* .

Step 6:
Reorder all of the images so that they play in the proper order.

Step 7:
No matter how careful you are in setting up all of the cameras chances are that you will still need to do some aligning between frames. Locate an object closest to the center of your shot. In this example I will be aligning based on the position of XP's eyes. In the timeline drag one frame onto a layer above the preceding frame. Set the opacity of the top image to 30%. Zoom in to 100% in the program window and drag the top image until the position of the eyes line up with the image below it. Once it is in place set the opacity back to 100% and move the clip back into place. Repeat this for every frame in the animation.

Step 8:
If you scrub through the animation quickly at this point it should look fairly smooth. When played back at slower speed, however, you will still notice the jumps between frames. To eliminate this go to Video Transitions -> Dissolves -> Cross Dissolve. Drag the Cross Dissolve icon directly in between frame 1 and frame 2. Repeat this for every frame.

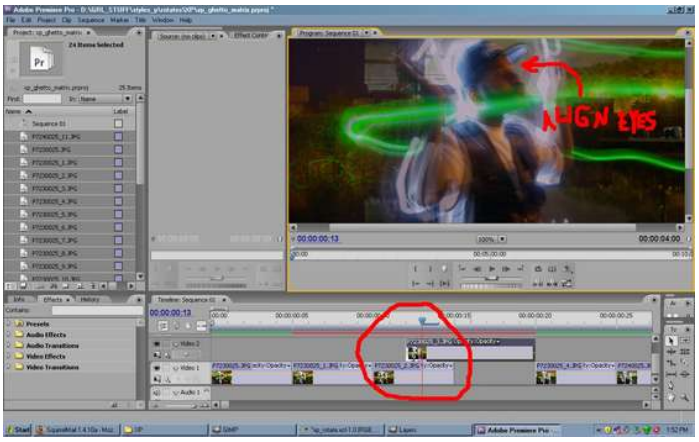
Step 9:
Export this sequence at 800 x 600 resolution.

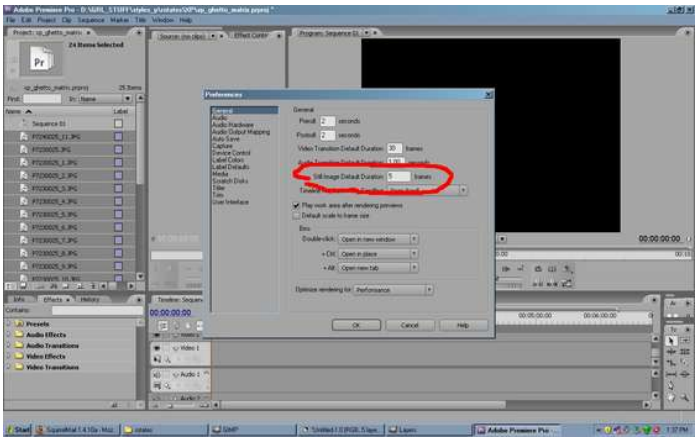
Step 10:
Because we moved around some of the frames in order to align them we are left with some frames containing black edges. To fix this open up a new project and set the width and height dimensions to 640 x 480. Import the 800x600 video and re-position it masking out any sections where the edges are black.

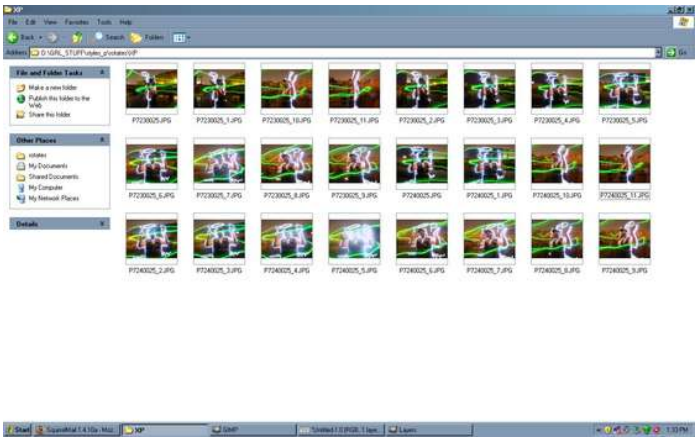
Step 11:
Export this movie and 640x480 and you are done.

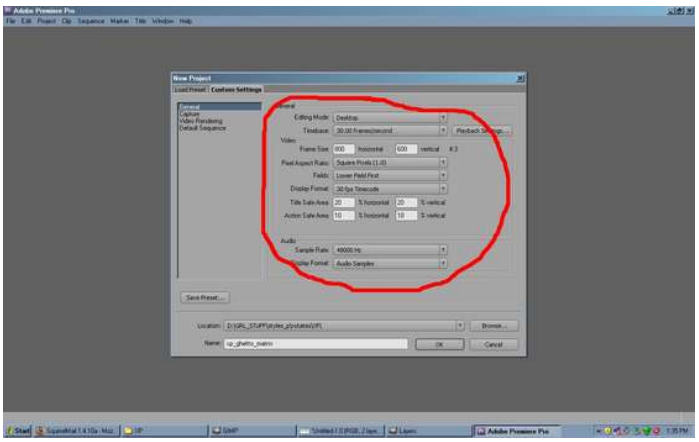
To view screen shots and all of the full resolution images in the sequence we used for this example go to:

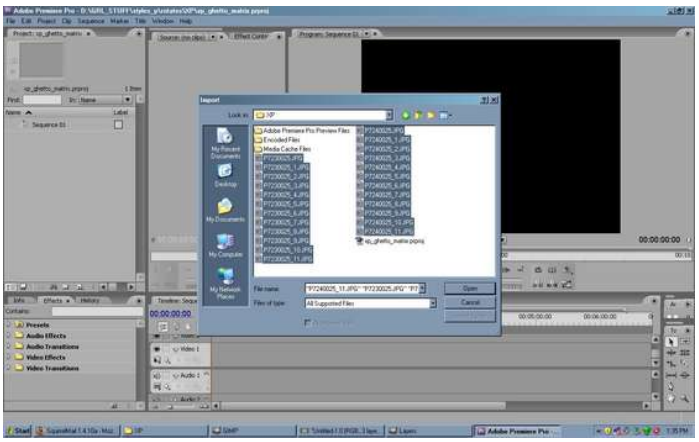
- http://fffff.at/fuckflickr/index.php?dir=data%2FGHETTO_MATRIX_HOW_2%2F

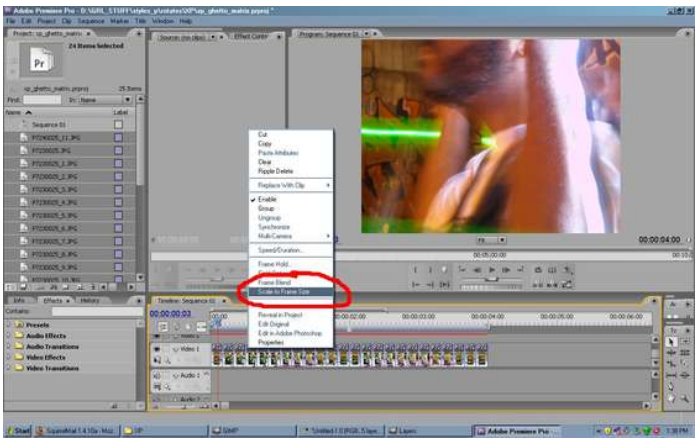


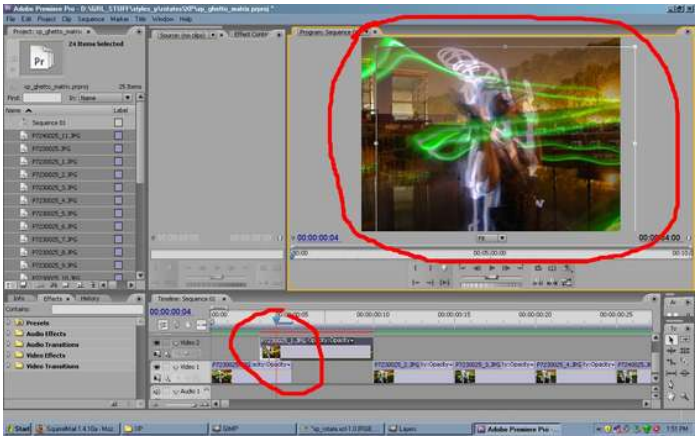


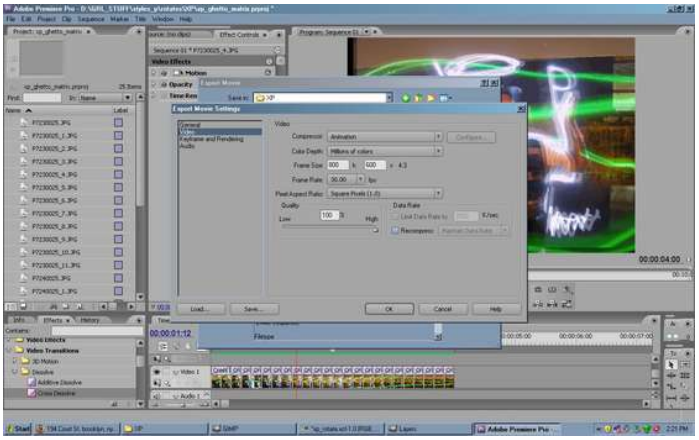


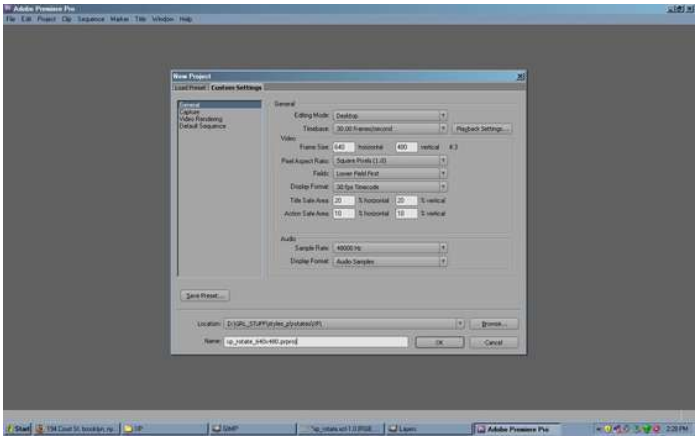


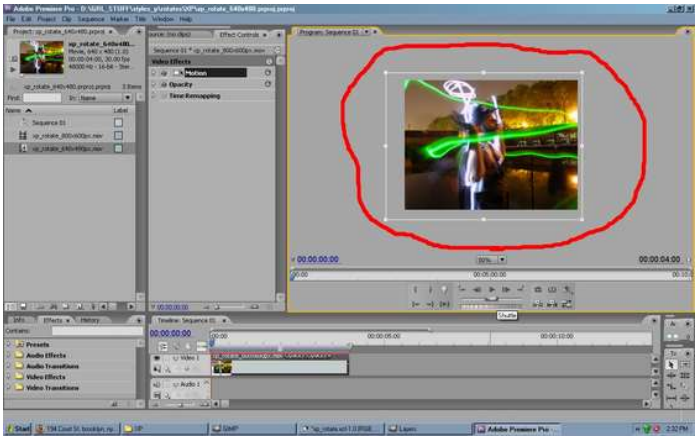


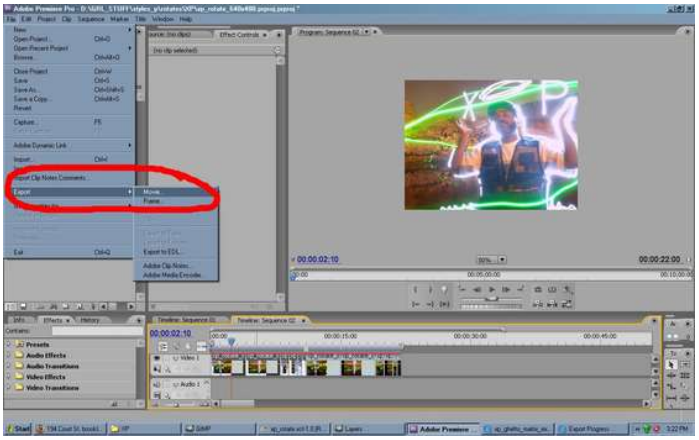












step 14: Fin

The potential of this particular system appears to be pretty robust. We done a few other experiments including a game of four-sqaure in the Matrix using live video in the two cameras on the end. Ill try to upload an example... but we've just scratched the surface.

To view an example of the animations created for the video go here :

Or on Vimeo here :

You can see how Dan used this system in the Styles P video on Yo MTV Raps or by clicking [here:http://videos.onsmash.com/v/4jylXUGElxGgycqg here]

So go ahead, take the red pill, use ubuntu, share torrents, contribute your idea to this technology, listen to rap. Hip hop saves lives. Repeat after me: "I got an open spirit hacker period!"

Shout outs from the GRL:
Big ups to Dan, Al and Bob who had the idea for and made most of the rig, 2esae for art directing most of the writing, Donna for shooting a lot of these photographs. Team G.R.L. ->Fi5e, Q-Branch, Borna, Bennett, West Coast Evan, Nate Nasty, Chris H, All City Crew, and especially Large Pro, who besides being hella cool and giving Borna the hat off his head, came back a month later to help raise money for 2esae's legal troubles , Styles P for letting us get involved in his business, Eyebeam for unknowingly allowing us to film portions of the video in the building and Brooklyn for being the original Ghetto Matrix. Free Every Graffiti Writer IN NYC . Peace.

Related Instructables

Matrix Bullet Time (the REAL way) by liables117

Electro-Graf by Q-Branch

How to Enter the Instructables and Universal Laser Cutter Contest by Contest Robot

Electronics - The Best of Instructables Volume 1 (guide) by StumpChunkman

The $2 LED Camera Light for Video and Photos by prodmod

How to Rap by DjProToJeeX

LED Matrix Test 1 using an AS1107 IC (video) by earthshine

My LED Throwies by zildjian

Comments

50 comments **Add Comment** **view all 96 comments**

fungus amungus says: Feb 20, 2008. 5:10 PM **REPLY**

This Instructable **won the $15,000 laser cutter!** Read more about it **here**.

palmettosky says: Aug 7, 2009. 8:03 PM **REPLY**

Or you could just do it with 2 cameras, Photoshop and AfterEffects like they did here at the 1:32 mark: http://www.hadlowpro.com/ . They do it many more times in this video too. I know for a fact that they did it with only two cameras and some rotoscoping and morphing.

MVD says: Feb 17, 2009. 3:43 AM **REPLY**

Safety tip, kids: Keep your fingers out of the path of the moving saw!

iTraceur says: Jul 29, 2009. 3:06 AM **REPLY**

Aw, no fun...

artseed says: Apr 29, 2009. 10:32 AM **REPLY**

This is definitely a great project, amazing results. While some of the costs may be out of reach for some you could still get interesting results if you used less cameras, it is still DIY. I made a few versions using 35mm film cameras photographing a whirling dervish, I hope to have time to post an instructable in july on my camera rig but until then you can see the results here: http://www.youtube.com/watch?v=KzL6fH-P0w8

cottonmoulthaz says: Jan 25, 2008. 1:14 PM **REPLY**
GRL is the dopest crew I have seen rolling other yet... my homeboy rolls with them and for whatever reason they need a laser cuter..... so I voted and you should too!!!!!!!!!!!!!!!!

csmiler says: Jan 24, 2009. 2:41 AM **REPLY**
dopiest?

hornysasquatch says: Mar 29, 2008. 5:47 AM **REPLY**
NOT A FAN OF RAP, BUT THATS A PRETTY SWEET RIG. BUT SEEMS LIKE A PRETTY STEEP PRICE TAG TO BE A "GHETTO RIG". LOW COST MAYBE, GHETTO, NOT BY A LONG SHOT. IMPRESSIVE TO SAY THE LEAST.

csmiler says: Jan 24, 2009. 2:40 AM **REPLY**
TYPE IN CAPS.....not good

Fasteners says: Jan 19, 2009. 9:12 AM **REPLY**
Again congrats guys...

Fasteners says: Jan 5, 2009. 10:29 AM **REPLY**
very nice work

setmefree says: Jun 14, 2008. 6:01 PM **REPLY**
I agree with a lot of you. This is not DYI. It actually looks professional, is too costly and is the same way done in the matrix. Nothing new, but i like the light effects around the guy.

shylock says: Oct 11, 2008. 5:51 AM **REPLY**
Absolutely this is DIY. That's what you do when you don't want to drop $100,000 to do it professionally... you "do it yourself"

static says: Jun 17, 2008. 11:16 PM **REPLY**
I'm confused ;) When did "looking Professional" and cost take a project out of the definition and realm if DIY? Respectfully all the comments in this vein sound no different than the sour grapes overheard at any event, when someone is judged to be a winner

nicenice says: Aug 12, 2008. 1:10 AM **REPLY**
wow!! Stop Motion? matrix :-))
after effect!
Adobe family lesson and stop motion =>www.newzatcekim.tr.cx
turkey in ege
?m sorry not spaek english ?m speak turkish
T?pk? matrix filminde oldu?u gibi.(stop maotion)
Bu yan?nda matör kalm??...
Bizim stop motion çal??mam?z? görmek isteyenler
www.newzatcekim.tr.cx adresine bakabilir.
(adobe ailesi tüm programlar? için ders verilir.)

shylock says: Oct 11, 2008. 5:49 AM **REPLY**
You could do bullet time if you used cameras that have the multi-shot option where they take multiple photos over a short period of time.

ultrauber says: Apr 13, 2008. 9:23 AM **REPLY**

Um...24 $300 cameras? That's a bit out of my league. And probably many others' leagues as well. That's like, what, $7300? Plus $150 for the light stands, and maybe $500 for all the other pieces and tools? You could buy a car for that much! Not saying it's a bad 'ible, but...whew! Pricey!

bumpus says: Apr 15, 2008. 2:39 PM **REPLY**

im thinking of a different way of doing the same thing, but with one camera...

ultrauber says: Apr 15, 2008. 3:55 PM **REPLY**

You could just record a video and have the camera roll on a track as suggested below or you could use a pulley system.

Sir Maverick says: Jun 2, 2008. 11:29 AM **REPLY**

You could but the camera would have to move really fast to create a bullet time effect. Also the frame rate would have to be high.

ultrauber says: Jun 2, 2008. 5:39 PM **REPLY**

Well, it'd still probably top off less than this.

Sir Maverick says: Jun 8, 2008. 4:52 PM **REPLY**

That's true.

daliad100 says: Aug 20, 2008. 7:26 PM **REPLY**

You could always try green/ blue screen

bumpus says: Apr 15, 2008. 4:25 PM **REPLY**

yeah, but i stuck with just taking pictures, the instructable will be up in a little while

ultrauber says: Apr 15, 2008. 5:11 PM **REPLY**

Can't wait for the 'ible.

I love italics in this font. I'm getting addicted! Help! 1234567890qwertyuiopasdfghjklzxcvbnmQWERTYUIOPASDFGHJKLZXCVBNM

bumpus says: Apr 16, 2008. 6:40 PM **REPLY**

haha, i'll try to get it up after school tommrow

ultrauber says: Jun 2, 2008. 5:45 PM **REPLY**

June 2nd rolls around

masterme120 says: Jul 18, 2008. 10:51 AM **REPLY**

You know, this wasn't really bullet time. In bullet time, each camera fires within a fraction of a second of each other, so that the actor doesn't even have to slow down. That's how they do it in the Matrix. It has an easter egg in the DVD version that explains this when you select an image of the red pill somewhere in the menus.

TeacherOfTheWays says: Jun 30, 2008. 3:09 PM **REPLY**

wooo! now go to the place of a sun banks ;-)

marty the fridge says: Jun 8, 2008. 6:57 PM **REPLY**

mmm tasty

scottbates says: May 30, 2008. 2:17 PM **REPLY**

anyone got a spare small fortune so i can make one of these. my spare film crew needed something to do

alex26i says: May 29, 2008. 1:49 PM **REPLY**

The only thing ghetto about this is the film they shot. The way the built the system is the same as anybody with money would build this system. Same as the HP commercial they have been showing.

Sir Maverick says: May 19, 2008. 3:17 PM **REPLY**

Anybody know of any interpolation software? (Just to fill in the in between frames/pictures?)

Thanks

Kimster says: May 12, 2008. 7:22 PM **REPLY**

CanÂ´t believe this won the 15k laser cutter!
I know I havnÂ´t posted any instructables myself and therefore it might be conceived as arrogant of me to criticise this.
But I am a fan of this site and I do think that its a site for and made by regular people.
And in the spirit of ingenuity, outside-the-box-thinking and DIY it is my firm believe that giving the prize to this "instructable" is a slap in the face to the sites regular contributors.
I mean, the bullet-time rig isnÂ´t really different to the ones used by (more) proffesional filmmakers - basically its a copy of the one used in the Matrix-series.....only difference being cheaper cameras, no blue (i.e. green) screen and less postproduction - but the setup of the cameras is nothing more than what anybody could learn from seeing the "making of" part of the Matrix dvds.
And furthermore the cost of the materials used makes this instructable useless for most (if not all) of the sites regular users - really, how many guys and girls who spends their time building stuff out of garbage and old pc-equipment has a budget pushing 10k for building a bullet-time rig?

The point being that this instructable isnÂ´t really that great - most people in here could have and probably would have built this if they had the budget.
And I would argue that a lot of the cheaper projects in here would be far more obvious candidates for the first prize - certainly in terms of ingenuity and DIY-ness.... If a bullet-time rig was to be the winner, the prize should have gone to the guys from The Matrix :-)

Best regards
Kim

m-arijn says: May 19, 2008. 1:41 AM **REPLY**

I agree

viviluk says: Apr 13, 2008. 7:50 PM **REPLY**

wowa! this is intense

RussNelson says: Jan 1, 2008. 1:27 PM **REPLY**

Do they have to keep saying fuck and mother fucker? And, not to whine too much, but the beauty of the bullet time effect is that in the Matrix, they go from movement, to stoppage, to movement. I watched the whole video and didn't see one instance of movement/stoppage/movement.

liables117 says: Apr 11, 2008. 5:10 AM **REPLY**

just throw a video recorder at the end of the line of cameras

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Full Frontal Graphic says: Mar 19, 2008. 12:40 PM **REPLY**

I somewhat agree, they did actually a chieve a very nice low budget bullet time RIG, but I am a little disappointed that it wasn't used to full advantage.

Since I haven't done an instructable yet, I assume I'll get some attitude for making a negative comment...

This is not to knock Grafitti Research Lab at all. I'm a big fan of their inventive projects and daring and all, but with that rig, I would just want to make some footage that really rocked our collective world.

The effect as GRL used it in this film (the bullet time shots) I believe I could do a similar thing with one video camera and a handful of still images, and Adobe's sick new Creative Suite... and leave some money in the kitty for the wrap party's supplies.

In fact, I guess I am just gonna have to see what I can do to put up an instructable about it,.

All my comments notwithstanding, I think this was an excellent project, maybe not Grand Prize material, but really up there in the winning zone.

DjProToJeeX says: Apr 9, 2008. 8:04 PM **REPLY**

i agree and posted to the likes. i like what they did but can we say overkill.

DjProToJeeX says: Apr 9, 2008. 8:03 PM **REPLY**

i think it woulda been cheaper to just make a track and a high speed camera and just have to roll start to finish like how it was actually done. seems like a lot of extra stuff for how to do bullet time. its a great concept probably the easiest for the basic user to make, to do this effect and the most expensive. and i agree with russ nelson. thats not the matrix effect at all. i think this instructable is 100 percent over kill. ive seen a group called digital visions do this effect first hand a few times with a much simpler rig for the 420 outlaws. and i thought this guide would be along the same lines as there rig. and as i saw it my first and only remaining thought is. why would you do it with so many cameras. it worked but the question is not if it would work. its with that many cameras dang how couldnt you get that effect to work.

alleyezonme says: Mar 29, 2008. 7:39 PM **REPLY**

I've seen people made this 4 times... It was presented at a mall once. its pretty cool when they show the results. they charge 2 bucks though...

micronxd says: Feb 29, 2008. 1:30 AM **REPLY**

Wow.... you guys have done outdone urselves again!

I friggin love it!

bullitje says: Feb 21, 2008. 2:06 PM **REPLY**

wow this sure is one of the best and most intense instructables ive ever seen

Tailslvr7_7 says: Feb 18, 2008. 7:21 PM **REPLY**

wow... this is sweet!

rogerthis says: Feb 14, 2008. 4:48 PM **REPLY**

Seriously cool. It looks like you are working with long exposures exclusively from what you have said. . . can you get decent sync if you wanted to trigger the shutters all at the same time? Decent for me would be 1/200 or faster. I am doing something similar with an array of Nikon 4300's but i have to use a long exposure and a strobe to freeze action.

sparkysteve says: Jan 17, 2008. 3:08 AM **REPLY**

Cool! You could make this much cheaper and use only 1 camera!
You will need to make a track on an arc along which the camera will travel. Then set the camera on multiple shots at what ever frame rate you require. Then set the camera taking shots and push,drag around the arc on the track. You can play with fps and speed along the track to get better images.

Nice work!

JordanZed says: Feb 11, 2008. 3:05 PM **REPLY**

That wouldn't work. It would if all you were doing was the rotation/bullet time, but for the light writing, it wouldn't work because light doesn't float in the air to let you take multiple photos of it lol. Good idea though if all you want is a cheap bullet time.

DavidD says: Feb 10, 2008. 8:37 PM **REPLY**

I am surprised it won as well. This isn't new and people have been using throw-away digital camera that were mod'ed to achieve this as well.

Fatvod says: Feb 10, 2008. 3:52 PM **REPLY**

I dont think this deserved it honestly. I think its fantastic and a very creative instructable. But who the hell on this site is gonna be able to afford a grand to build this thing??? I mean most instructables are something anyone can do with minimal cost. But id be suprised if more than 2 people build this thing. Im not trying to criticize this I think its very cool but not worthy of the prize.

view all 96 comments