Laser Surveillance System for under $20

by navaburo on July 15, 2006

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Author:navaburo author's website
I am a student and hobbiest. I'm into physics, linguistics, sailing, electronics, hacking (not cracking), music, and the like.

I post most of my project stuff on my blog: http://hotwigati.wordpress.com/

Whenever of my projects becomes, er..., repeatable I will make an instructable for it.

Happy Hacking!

Intro: Laser Surveillance System for under $20

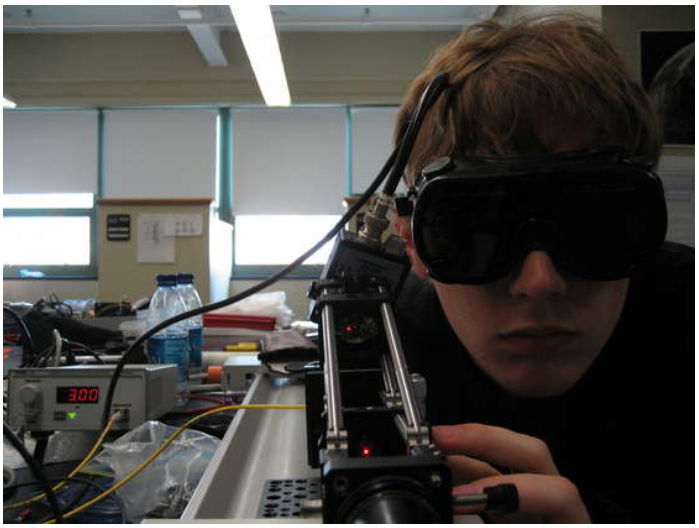
WARNING: this project involves the use and modification of laser devices. While the lasers I suggest using (store-bought red pointers) are relatively safe to handle, NEVER LOOK DIRECTLY INTO A LASER BEAM, BEWARE OF REFLECTIONS, and be EXTREMELY CAREFUL when MODIFYING a laser product. Also, I am not liable for anything stupid you do.

Using a basic laser pointer and a sensitive amplifier it is possible to listen in on conversations through exterior windows! The price of $20 is simply an estimate, in my case I did not need to buy anything.

The system described in this instructable works on the same principle as commercial projects like this:
http://www.electromax.com/laser.html http://www.electromax.com/laser.html

NOTE: For a similar projects that may be of interest, check out my blog check out my blog. You may find of particular interest the Polarizing Laser Music Mixer! Polarizing Laser Music Mixer!

(Photo of me in the lab, with my own bad-ass glasses, replacing the random military dude who was there before.)



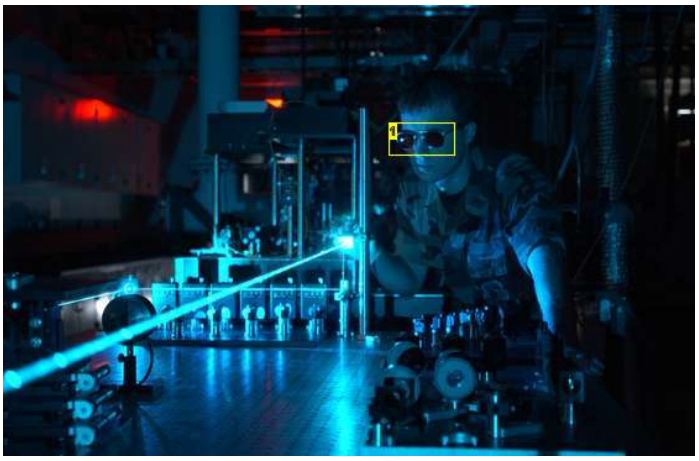


Image Notes
1. Bad ass glasses

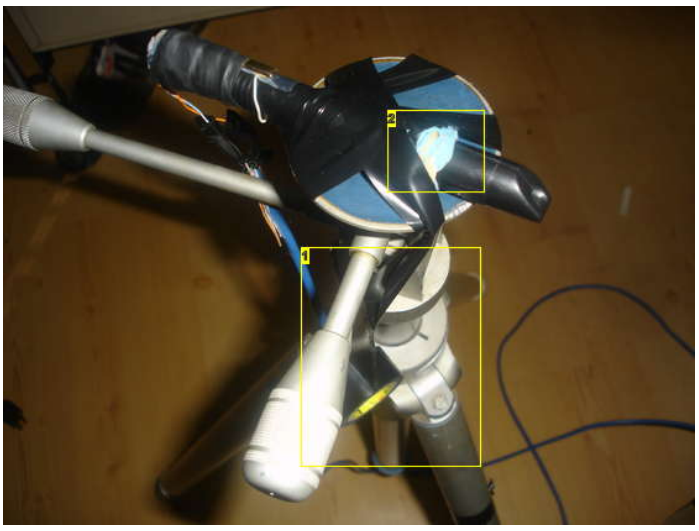


Image Notes
1. tripod is a must for stablility
2. power button is jammed ON

Step 1: Gather Materials

All you need for this project is:

a building with a window to be listened-in on
a laser pointer
a tripod
electrical tape
a magnifying glass
a phototransistor (aka IR detector, can be gotten from remote control recievers)
microphone preamp and amplifier (this can be replaced by a laptop with a MIC port)
an extention chord or batteries for the preamp/amp
someone to listen in on

optional stuff:
a potentiometer (to control the laser brightness)
an infra-red laser (so the light can not be seen)
a digital camera (to see the infra-red laser during calibration)
extra bateries for the laser (upgrade to D cell or something)

(some of the needed equipment is shown below)

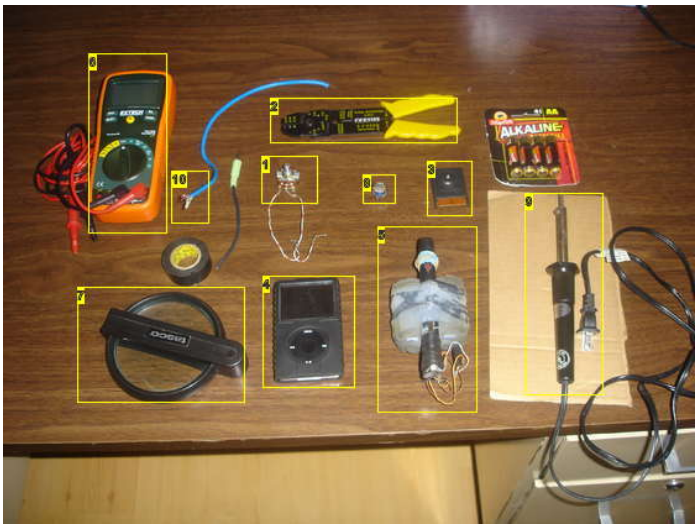


Image Notes
1. 50k ohm potentiometer
2. multi-tool (stripper/cutter/crimper)
3. phototransistor from RadioShack kit
4. duh
5. laser with attached 2xD battery pack
6. digital multimeter
7. large magnifying glass to refocus signal after a distance of travel
8. audio transformer
9. $8 soldering iron
10. cat5 ethernet cable the small wires work great for projects like this

Step 2: Attach the Laser to the Tripod

Tightly attach the laser to the tripod with tape. Also tape or rubberband down the power button so that the laser stays on.

In the photo below I also attached wires that run to an external battery pack for extended life.

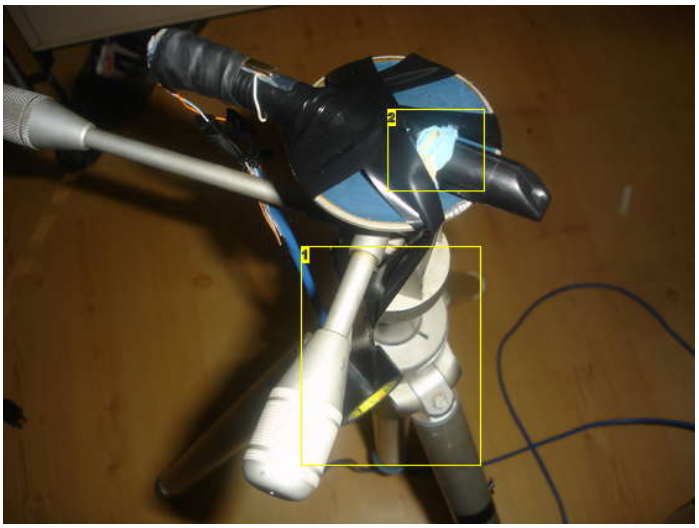


Image Notes
1. tripod is a must for stablility
2. power button is jammed ON

Step 3: Rig the Reciever

Phototransistors work very similarly to microphones in that they vary the current they allow to pass through them when exposed to chaning light levels. So, treat the phototransistor like a mic, and attach it to the MIC port on a laptop, or to the MIC terminals of a preamp, then hook the output of the preamp to the input of an amplifier.

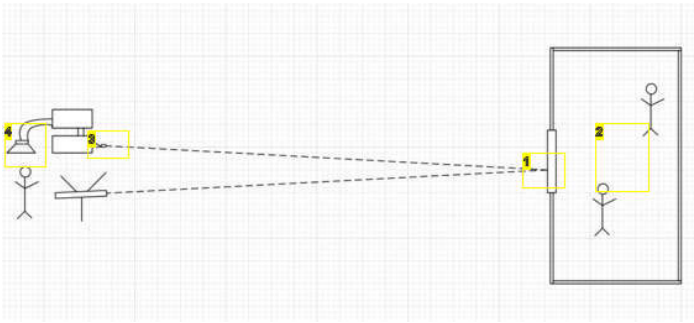
If you are using a preamp, you should be able to screw the leads of the phototransistor right onto the back of the device, but if you are using a laptop, you will need to tape or solder togeather the pins of the phototransistor to the wires of a stripped headphones chord. Remember the ground (-) lead of the phototransistor is the one that has a little flat spot on the plasitc. Look to the photos for help.

Image Notes
1. IR/red light reciever
2. magnifying glasses or parabolic mirrors work wonders for increasing signal strength

Step 4: Position your Spy Gear

Find a target building and window.

Look at the drawings below to help with the positioning of your gear.
(this only works if you are at the same elevation!)



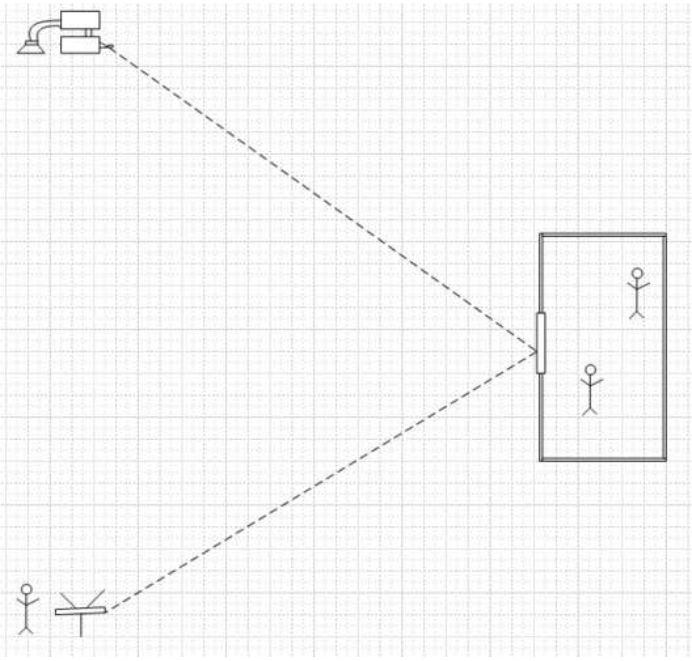


Image Notes
1. targeting is tricky. You may want to use a telescope to help point the laser.
2. conversations go on here
3. getting the return beam right on the reviever is key.
4. conversation heard here

Step 5: Aim the System

Stand by the laser tripod. Aim the laser at the window. You should be able to see the reflection of the recieving equipment in the window. If not, reposition the laser or the reciever until you can. If it is dark out, turn a flashlight on near the reciever pointed at the window, that way you can see the reflection in the window and locate the laser appropriately.

Once the laser is aimed, look for the reflected beam/dot near the recieving station. White paper or cardboard (pizza boxes) can come in handy. Position the phototransistor in the beam.

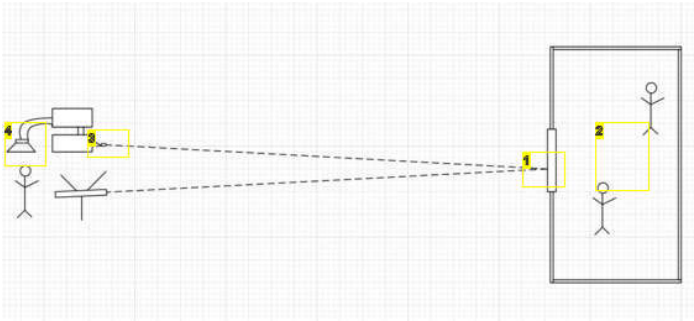


Image Notes
1. targeting is tricky. You may want to use a telescope to help point the laser.
2. conversations go on here
3. getting the return beam right on the reviever is key.
4. conversation heard here

Step 6: Magnify

Position a magnifying glass in front of the phototransistor, in an attempt to focus the beam. You should hear the most noise from the amp when it is positioned correctly.

At this point you may need to adjust the volume on the amp and preamp. Turn it up until you hear feedback, then turn it down until it goes away.

Image Notes
1. IR/red light reciever
2. magnifying glasses or parabolic mirrors work wonders for increasing signal strength

Step 7: Give it a Try - Taking it further

Listen for voices. You should be able to hear the low frequencies of any conversation inside the room of the targeted window. If you cannot hear anything, try banging on the window! That should produce a VERY loud sound from the amp.

If you get this project to work, the worst thing you could do is stop there! Try to build on the project. Try more than one laser, or getting more distance, or whatever comes to mind. One thing I have done to extend the project is to send music over the laser beam, and even sending two channels of music using two lasers polarized at right-angles to one another.

Feel free to leave some comments.
Happy experimenting!

Related Instructables

Home surveillance via Twitter and YouTube by maskedavengers

Transform your laser pointer to a "spot-flash light" :) by zholy

Spy ipod earphones with hidden microphone by nikk985

New 007 Laser Weapon - Revealed! by Kipkay

Hack The Spy Ear and Learn to Reverse Engineer a Circuit by Biotele

Make a James Bond Spy Car (w/ Weapons) and a Spy School Halloween Display by ThawedHead

Comments

50 comments **Add Comment** **view all 184 comments**

AbaddonSpirit says: Sep 24, 2010. 10:48 AM **REPLY**

These laser bugs are fun! Here is another nice one...

http://www.lucidscience.com/pro-spy%20gadgets.aspx

Now the neighbors are no longer safe!

frogjake9 says: May 20, 2010. 12:16 PM **REPLY**

Where can I get a microphone preamp?

Djdavies83 says: Mar 25, 2010. 3:28 PM **REPLY**

sending 2ch stereo over laser using polarized beams is interesting, the cheap plastic "REAL-D" 3d glasses you get from cinemas for about 75p ($1) would be a start.
what about the receiver? a kinda 2way mirror at 45D to split the beam in two then use two phototransistors?

navaburo says: Mar 25, 2010. 8:49 PM **REPLY**

You could use the linear polarization filters from traditional polarized 3D glasses. The Real-3D glasses however use a combination of quarter wave-plates and linear polarization filters to enable decoding of circularly polarized light. So, you are better off using the old (and cheeper) glasses, or ordering a larger sheet of filter from a supplier.

If you want to see a working 2ch system in action, check out my blog post where a few guys and I tried it out. Rough schematics and video included:

http://hotwigati.wordpress.com/2008/11/15/polarizing-optoacustic-mixer/

Happy Hacking,
Chris

Sanctus says: Jun 24, 2008. 2:35 AM **REPLY**

"If you cannot hear anything, try banging on the window! That should produce a VERY loud sound from the amp." I just imagine the sound AFTER banging on the window: Oh, dear what is that? is that a bird on your 154th floor just banged? Oh no, it's the laser spy just testing their gear! ;)

beehard44 says: Feb 11, 2010. 4:24 AM **REPLY**

Or light a c4 parcel, throw it at the window with timing and you'll get what you want.

faruksam says: Sep 30, 2008. 6:38 PM

(removed by author or community request)

bowmaster says: Nov 16, 2008. 12:19 PM **REPLY**

It's not in English.

conrad2468 says: Mar 17, 2009. 8:43 PM **REPLY**

sooo....use a translator dont just remove it....

stormende says: Jan 17, 2010. 5:29 PM **REPLY**

LOL

Tienes toda la razón!

I mean you are darn right about that, Conrad.

:D

mikemmcmeans says: Jan 12, 2008. 4:32 PM **REPLY**

where can i find these damn "audio transformers" ??!! F@*$ links part numbers anything??? somebody help me pleaseeeeeeee

Colonel88 says: Aug 16, 2009. 1:02 PM **REPLY**

Thos ol' 56Kbps modems; i got mine from there

truespin1208 says: May 2, 2009. 10:45 PM **REPLY**

radio shack $3

legionlabs says: Jun 24, 2008. 11:43 AM **REPLY**

http://www.digikey.com

Search "audio transformer".

(I am not affiliated with this vendor)

conrad2468 says: Mar 17, 2009. 8:46 PM **REPLY**

(scumbag lawyers made people start saying that) he he he he he

honsoworld-bro says: May 21, 2009. 3:19 PM **REPLY**

where do you find ir lazers can you give me a link if you know where

junits15 says: Apr 5, 2009. 8:58 AM **REPLY**

sick!

seanpcurto says: Apr 18, 2008. 4:15 AM **REPLY**

Question: Can invisible IR lasers be used to do this also? I have some 15mw infrared lasers, I think? but defiantly NOT 625 red or LED) as shown in the 2 pictures (I have 9 of these that slightly vary in specs) Can these be used in place of lasers that operate within the spectrum of visible light? If so so I was thinking of mounting a visible laser along side of it along the same X and Y axis to spot a sight to listen in on without leaving a continuous laser dot on someone's window. (Something to consider carefully BEFORE you select an audio source if you're using visible lasers for this purpose.) How would IR lasers perform in this application and what modifications if any, would be necessary? If IR lasers work, you could then listen in at night without causing them to duck and crawl for home protection mechanisms :) Any help is appreciated and if I build one, I'll post an instructional on it! Thanks for this awesome instructional navaburo, and I like you pic and lab better the military one. It show that we can pursue our own dreams in our own way without having to kill people.

conrad2468 says: Mar 17, 2009. 8:44 PM **REPLY**

use a good camera (the kind you take pictures with) to find the IR dot on the window.....

navaburo says: Jul 30, 2008. 8:40 PM **REPLY**

Go for it! I see you have some ~850nm diodes, perfect! There should be no modifications necessary, assuming you have a typical photodiode/phototransistor (which has a peak responsiveness of ~900nm). Just keep in mind that IR lasers are VERY dangerous, since you can blind yourself without knowing it is happening! Definitely don't actually shine this into someones window without them knowing. And, for testing/alignment purposes, you can use a standard digital camera to see the IR. (Putting ~10 pieces of Congo Blue theatrical gel in front of the camera lens will make it SUPER easy to see the IR light with the camera.) Tell me how you fare!

insmnc! says: Jul 30, 2008. 6:39 PM **REPLY**

i got a question for you. where can you find an ir laser? any links?
also i have a suggestion. there are some goggles you can make with theatrical gel that lets you see along the ir spectrum here is the link

http://www.instructables.com/id/Homemade-Infrared-Goggles!-For-Under-$10/

let me know what it does if you try it!

navaburo says: Jul 30, 2008. 8:35 PM **REPLY**

I have infact built those ir goggles. They are pretty cool on a sunny day outside. They will NOT however allow you to see beyond 800nm into the IR. Here is how they work: I. Your eyes can naturally see between 700nm (red) and 400nm (violet) quite well, but are still somewhat sensitive to light in the range of 700nm to 750nm. II. The region of the EM-spectrum between 700nm and a few microns is traditionally called "infrared". III. The goggles block out everything but 700+nm. RESULT: Naturally, you do not notice the ~720nm light because your eye's sensitivity to it is so low, it is drowned out by the other, more visible wavelengths. However, when you are wearing the goggles, all that reaches your eyes is 700+nm light. So, your pupils dilate and you go into your "night vision mode". Dimly through the goggles you will then see everything in a shade of red (that appears grey after using the goggles for some time). This light is all 700+nm so it is officially IR. NOTE!: you will NOT be able to see (most) IR lasers, because (mostly) they work somewhere between 800nm and 1500nm. To see those you will need an IR camera (for near-ish IR, i.e. 800nm, you can just use a consumer-grade point-and-shoot CCD camera).

insmnc! says: Jul 30, 2008. 9:58 PM **REPLY**

would be able to see the laser on a bright day if i used my camera? also would 850nm be the best diode to get? and would a cadmium sulfide photocell be responsive to infrared?

navaburo says: Jul 31, 2008. 9:26 AM **REPLY**

Putting ~10 pieces of Congo Blue theatrical gel in front of the camera lens should make it easy to see the IR light with the camera, even in sunlight. You will have to check the datasheet on the CdS cell to see what its wavelength responce is/

bgugi says: Jun 26, 2008. 5:28 PM **REPLY**

infrared lasers are quite easy to get hold of - they are the lasers used to read standard cd's. in fact - the blu-ray diode of the ps3 is a triple-stacked diode: 405nm(blue, blu-ray), 660nm(red, dvd), 780nm(red, cd)

Derin says: May 29, 2009. 10:18 AM **REPLY**

That's only true for backwards-compatible ones.

MrPhelps says: Jun 24, 2008. 1:10 PM **REPLY**

It will work but targeting will be much more tricky. Also check the response curve of your phototransistor to make sure it is sensitive for the wavelength of your laser (most phototransistors are sensitive to IR) Also, do not attempt to point this at people, invisible lasers are really dangerous because they do not cause the reflex to look away, and 15mW is quite enough to blind someone.

94 says: Aug 14, 2008. 4:52 AM **REPLY**

Ok you guys will think this is funny. If you know your being spyed on just constently move the window. These things work by *feeling* vibrations. So but somthing that buzzes on the window.

Delvie says: Feb 6, 2009. 3:03 AM **REPLY**

There was an episode of Burn Notice where they knew they were being listened to by laser so they taped a turned on vibrator to the window.

conrad2468 says: Mar 17, 2009. 8:41 PM **REPLY**

how appropriate.....

alexh934 says: Feb 25, 2009. 1:36 PM **REPLY**

Do you need the radioshack circuit board kit to make this? and is that a 50k ohm linear taper potentiometer? And i cannot find an infared laser, will red work?

navaburo says: Feb 25, 2009. 7:04 PM **REPLY**

No, you don't need the radioshack board. It was just a convinient platform to build upon. And I would recommend using a RED laser first, because infrared lasers can be dangerous (You can't tell when your eyes are being damaged!). - Good luck!

munzer says: Sep 22, 2006. 2:19 AM **REPLY**

Would one be able to do the same, but in reverse? Could a signal or vibration be sent to the window by the lazer? Could a signal be strong enough to vibrate the window?

curecreator says: Jan 25, 2009. 6:43 PM **REPLY**

This link isn't direct laser communication but it is a way to transmit data through laser beams (especially sound)

http://www.metacafe.com/watch/2225704/make_a_simple_laser_communicator/

It has only been tested by transmitting sound but other encoded data should work to.
Also this actually is direct communication except it is transmitting data in area of affected particles that cannot be heard (the electromagnetic spectrum)

soapy says: Aug 29, 2007. 10:45 AM **REPLY**

No chance. Thermal shock from that much laser would shatter the glass long before any noticeable vibration was set up.

beehard44 says: Feb 11, 2010. 4:22 AM **REPLY**

Which is cooler...

stick C4 in any object, light it and it will instantly be cooler.

Capricorn.san says: Aug 9, 2007. 2:40 PM **REPLY**

whilst you cannot rely on the photon momentum to generate vibrations, with a powerful enough laser, one could generate localized heating in certain areas to generate thermal differentials that vary with time. These differentials could generate enough stresses to cause the glass to vibrate. It does however rely on the thermal properties of the medium you want to vibrate and the power of the laser. and you have to have some nicely coordinated movement of the laser to create this thermal wave.

navaburo says: Sep 29, 2006. 11:16 AM **REPLY**

in theory, yes. Photons have non-zero momentum. So by relecting light the window does diflect a slight bit. However, you would need a laser so powerful that the window would melt before you were able to move it.

Crazysmart-stupidguy says: Dec 5, 2008. 7:43 AM **REPLY**

I'm not that good with robots, but could you possibly mount this onto a remote control robot, along with some adjustments, make it portable. Again, im just new to this so yea...

Carlos Marmo says: Oct 30, 2008. 3:53 PM **REPLY**

Wonderful Work! Congratulations!

Gilly001 says: Oct 21, 2008. 3:44 AM **REPLY**

with the mic port on a laptop, could someone please give me the details to get it into the port. Like, connect the wires and all. thanks.

jsgski says: Aug 8, 2008. 8:36 PM **REPLY**

I made one of these 20 years ago. It was on a bet, which I won. I won't go into the details (yes, I'd have to kill you) other than to say that security people often over estimate the effectiveness of their countermeasures. This kind of system does work but there are some "enhancements" that can make it work better. One is targeting. I used an "imaging" plate to visualize the IR spot on the target. Basically this was attached to a beam splitter attached to a telescope sight. The imaging plate caused the reflected IR spot to create a visible light spot superimposed on the visual field. I had access to some fairly insane hardware back then but today you could probably do it cheaper. Another is modulation. There are SNR improvements that can result from chopping the beam and recovering with either an analog commutator or DSP - makes the system more insensitive to ambient light during the day and ambient IR generally. There's a last hack but I won't mention it because you have to have exceptionally pure laser spectra that can't be had from any off-the-shelf IR laser. You might be able build something clean enough but it's not that easy.

-ddrblank- says: Jan 6, 2008. 12:16 PM **REPLY**

I'm in the process of creating this into a wrist watch. Right now its going OK, I'm looking for a laser at the moment. But I don't understand how the audio transformer and phototransistor fit into it...

legionlabs says: Jun 24, 2008. 11:41 AM **REPLY**

A phototransistor is a glorified photodiode that applies voltage to the base of a transistor.

A photodiode is (basically) any diode where the semiconductors are exposed to light, so that it demonstrates a photoelectric effect like a solar panel.

So, the role of the phototransistor is to transform received light that bounces off the window into a voltage, and amplify that voltage. A perfectly flat window is optically a semitransparent mirror, as it vibrates due to sound it becomes alternatively a convex or concave reflective surface, which changes the intensity of the received radiation.

A second way to accomplish this is to pulse a laser at the window at a high frequency. The reflected light will be *both* amplitude and frequency modulated. The frequency modulation would allow for good resolution if you can make the pulses fast enough.

richelton says: May 26, 2008. 4:38 PM **REPLY**

I have a question about the 'critical positioning' of such a setup and the return angle of the laser reflection. I often see it stressed that one must position the rig precisely perpendicular (X and Y) to the plate of glass off which one is bouncing the beam or else calculate angles to receive the reflection. However, could you not affix a small piece of retroreflective tape (or a small bicycle reflector) to the window so that the beam is returned back parallel to but in the exact opposite direction as the laser painting the target? That way you could keep the rig together and paint the target from almost any angle you like--including extremely low (i.e... target is a window up on a highrise) or extremely high (i.e. you are up on a highrise with a great vantage point possibly for multiple targets). I've just never seen this point mentioned in discussions of laser-reflective audio surveillance and it seems a pretty obvious improvement.

HuggyBear says: May 20, 2008. 5:55 PM **REPLY**

My only concern would be the light that is not reflected by the window. Like others have said, there would be a giant dot where ever the laser was pointed. An IR laser would probably work but setting up the system would be extremely difficult (you have to aim it correctly even though you cant see it). Other than these dilemmas which I dont blame you for, your construction is awesome. Something I most definitely have to try when I come across a laser pointer.

sam noyoun says: Mar 31, 2007. 5:45 AM **REPLY**

A few questions (they might be silly ones, I don't know, I'm not very scientifically minded...): - What if you shone your laser through an infrared filter? I guess what I mean is: do green/red lasers emit any infrared light that could be filtered? - If I were to use processed negative film as an infrared filter, would the laser burn a hole through it? - What strength lased did you use? - Would plugging the mic. jack into a MP3 player, rather than a laptop still work?

Meispantyshot says: Mar 28, 2008. 2:52 PM **REPLY**

Answers to your questions: - Green lasers put out IR as well as the 532nm green light. The amount put out varies from laser to laser, with variances in crystal quality and pump diodes. I have a 200mW portable laser (that puts out a little over 250mW avg of 532nm green, and up to 50mW of IR light) that will put out IR, but the intensity of the IR drops to almost ambient when farther than 10' from the aperture. - Again, it depends on the power of the laser. My 30mW green will slightly melt/distort the black plastic, and my >250mW would destroy it instantly. - The mp3 will work if it has a mic input and can record.

Einsteins Circuitry says: Jan 12, 2008. 6:09 PM **REPLY**

Lasers usually only emit ONE specific color wavelength. (red=632, green=543, and IR=808) But there is always an exception to every rule. The exception is that green lasers radiate IR light. This light is invisible to the eye, but is still harmful. The IR light radiated from the green laser is not a beam. It is more of a spot-light.

navaburo says: Apr 7, 2007. 10:31 AM **REPLY**

- lasers only emit a single wavelength of light, so a green laser emmits only a negligable amount of infrared.
- depends on the strength of the laser (a laser pointer shown here, definately not)
- I went into staples, office depo, and wallmart and looked at their laser pointers. Then i bought the cheepest one i could find that was actually a laser (some of the "laser pointers" just have a red led and their beam diverges very fast, so it is useless). Long story short, a rather weak laser.
-the MIC output from the laser reciever needs to goto an amplifier or pick-up of some sort. Plugging it into an MP3 player will do nothing.
However, you _can_ use the MP3 player's signal to modulate the laser beam at the transmitter, and you will hear the music at the reciever. For that, look at this project: http://www.instructables.com/id/EEPBZGCJP1EPH67K7Q/

> they might be silly ones, I don't know, I'm not very scientifically minded...
they are good questions nonetheless. what good is a scientist if he keeps his mouth shut.

view all 184 comments