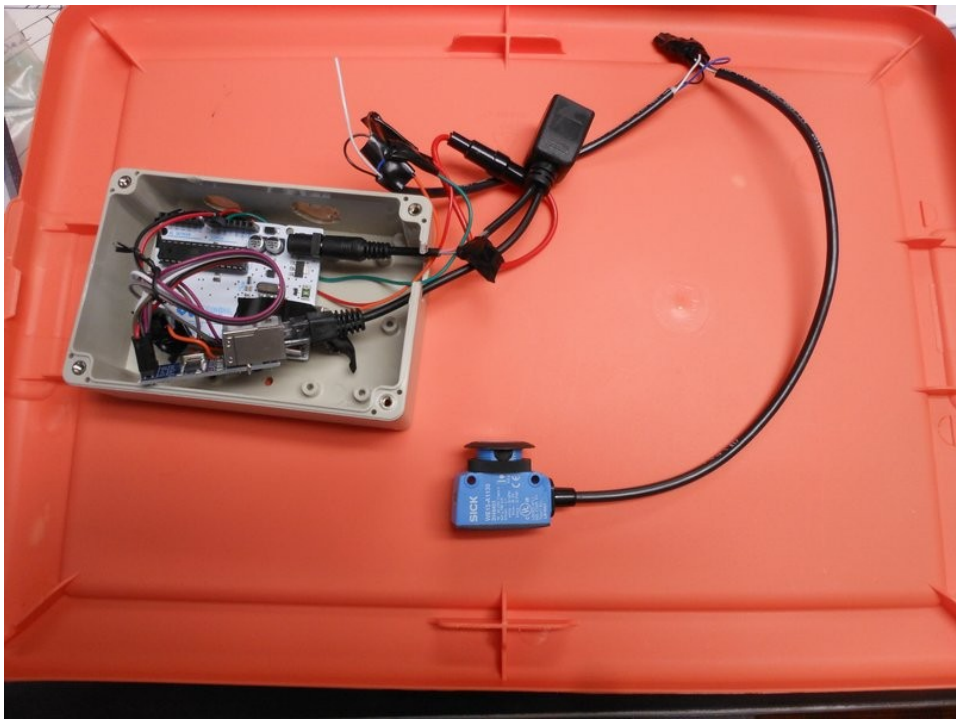
ZMHW Project

Infrared Diode Laser Motion Sensor

Objective: To make a motion sensor that acts as motion detection for Zoneminder cameras. As the cameras often have false alarms, an external sensor is a possible solution. This uses a Laser Diode Infrared Sensor.



Main half of the sensor before putting in enclosure.

Parts List:

Arduino Uno (official recommended)(DIP recommended)
ENC28J60 ethernet module
Passive PoE adaptors for IP Cameras
Series 1A fuse
Sick WS15-D1130 Infrared Laser Diode Motion Sensor
General Purpose Diode (I used 1N4818 diode) (may also use transistor, per data sheet for Sick)
Jumper Wires
Copper Wire (22-26 gauge)
Enclosure
Ethernet Wire
(optional) Low Profile one and two gang wall outlet
(optional) Blank cover plate, for one and two wall gang wall outlet
(optional) Electrical tape (I prefer halfway decent electrical tape)
(optional) piezo speaker
(optional) extras of everything, in case anything fails

Work Log:

This work log will be pictures with some notes thrown in. I'll try to make note of all important parts.

Device was assembled and using the ZMHW Project source code. This is simply an Arduino sketch with UIPEthernet (to use the ENC28J60) (make sure CS is pin 10 on Uno). For more details see source code. Explaining the details is out of the spec of this doc. Simply put, the ENC28J60 is connected, the Sick sensor black wire is connected to Analog input 1, and a speaker is connected. See source code. I will try to put a fritzing diagram in the git repo.

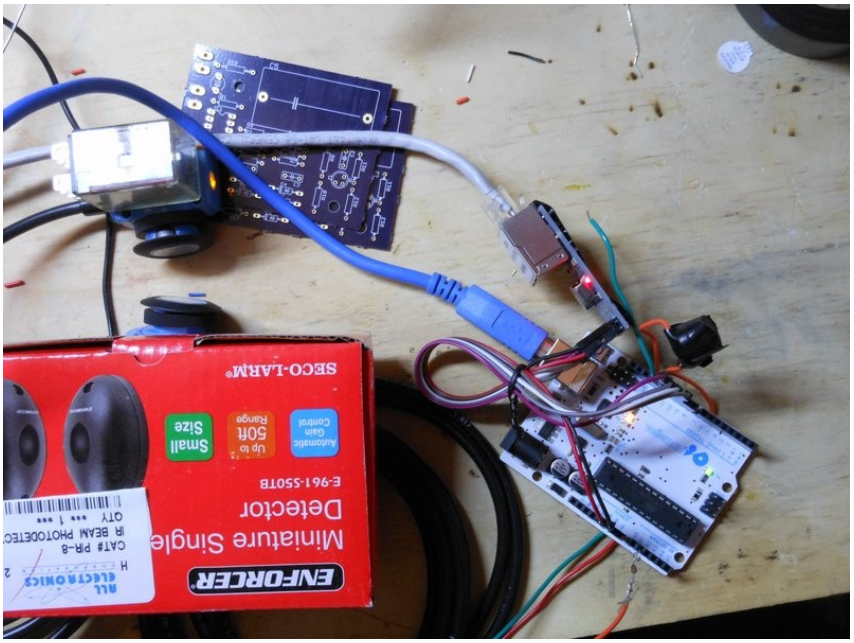


Figure 1: Orange LED on top of sensor when link detected. Series diode on output of sensor to cheat the need for transistor.

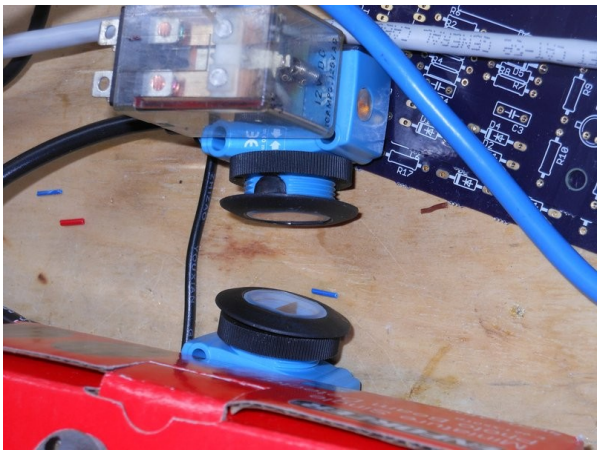
Of importance, **Figure 1** shows two things, first off a diode connected in series with the output of the Sick sensor, and also the orange LED on the top of the sensor. The orange led will be green when there is no connection between the diodes and orange when the Laser Diodes (or LEDs) are lined up correctly. When someone moves across the field of their vision, the orange LED will change to green.

Diode on output of Sick sensor

Some laser sensors output a high or low. Some, like the Sick sensor, output a high or low (depending on whether you connect to white or black wire), however they are meant to be connected to a transistor, and thus if you connect it directly to a micro expecting it to go high or low, it will not. I dont want to deal with a transistor as I am lazy, so instead I put a 1N4819 in series with the output of the Sick sensor. TODO: pictures showing waveforms

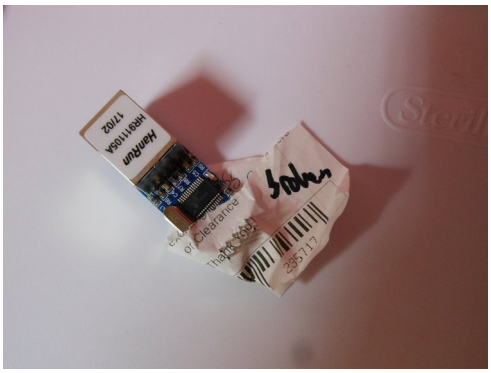
Using the black wire, it will be normally low and go high when motion is detected (the white wire is the opposite). If you connect to a micro it will fail to go high (why?). If you put a diode on the end in series, it will turn the normally low to a noisy normally low, and sometimes it will go between 2.5-5 volts in spikes. This allows us to use the ADC to read the Sick sensor, and avoid the use of adding a transistor in. The transistor would allow for a digitalRead to be used, but we have plenty of Analog inputs to use, so let's use one of those.

It's very important to line up these sensors. If they are not lined up precisely, they will not get a sync, and the motion detection will fail. This will become important later, when we install.

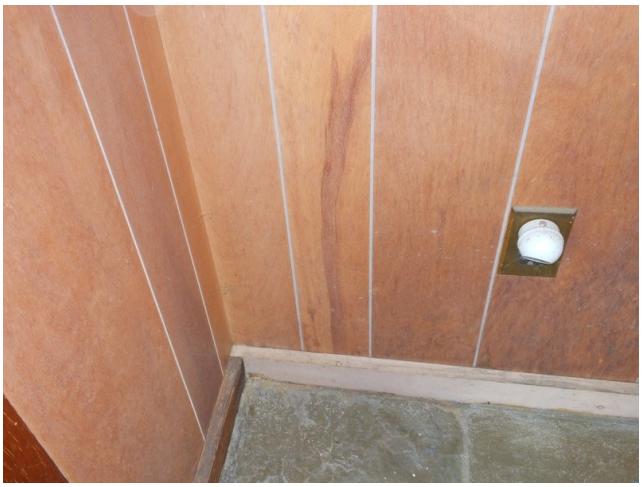


Broken ENC28J60
During my testing, I suddenly was unable to get an IP address. I checked the example sketches, then began tearing down my setup, testing another Arduino and ENC module.

It turned out, the ENC28J60 module failed on me. Make sure to buy backups.

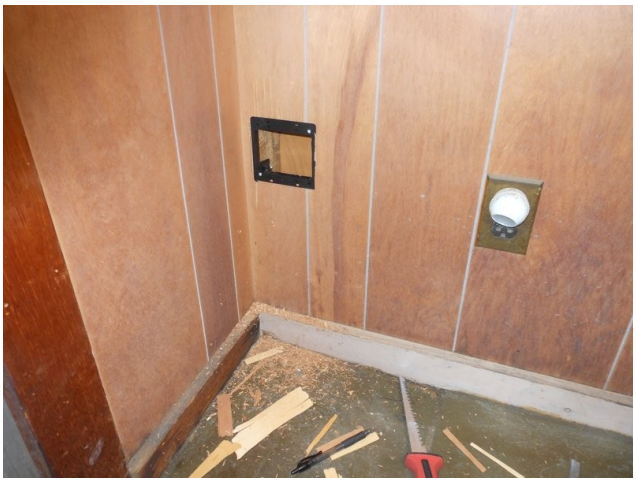


Picture Log:



Choosing location for the sensors. Keep in mind, that the laser diode path must remain open. This is where the main board and sensor will be.

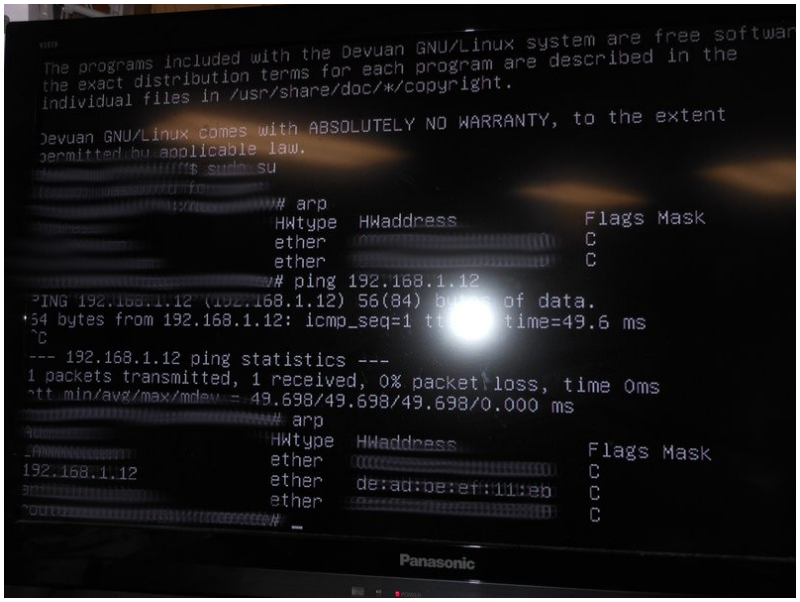
Feeding nylon string, and a wire up from the bottom of the wall to the ceiling. This is where the single sensor will be.



Low profile two gang wall plate installed.

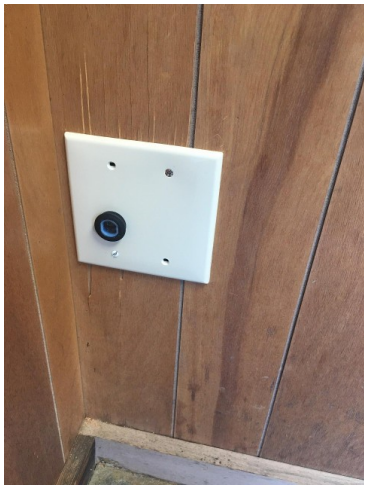
Installing the single sensor. I used ethernet as the power line. I also used a passive PoE adapter on both sides to transfer the power onto the ethernet, and back out to a 5.5, 2.1mm barrel plug

Box installed on the wall. This is a temporary box I used for testing purposes. The additional hole at the top is an error, but allows viewing the LED (though this sensor does not change its LED colour, it's always green).

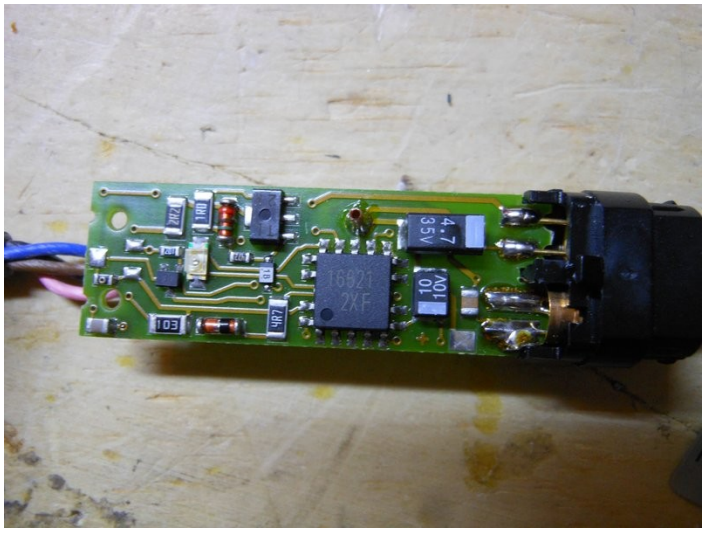


Checking the device is on the Camera LAN by pinging it, then reviewing the arp tables to make sure it's the right device (IP is static, so it's possible a conflict could arise)

This mangled web of wires, is a temporary testing ground, while I go to the store to purchase a two gang blank plate. In this setup, I will calibrate the diodes to point correctly at each other by setting this double gang receiver diode to be fixed, and then adjusting the opposite laser diode. For testing though, some electrical tape, and the power wire pulled out will do temporarily. When the lights are off, the red diode light is more visible and may be easier to calibrate.



Here's how the outlet looks just before putting the final machine screws in. It was important to buy a "non breakable" wall plate (essentially a bendable more rubberized one), as the normal wall plate, simple shattered when drilled into. The non breakable version worked well with the drill.



Omrom Motion Sensor

All electronics is also currently selling used Omrom photoelectric sensors, they are model: e3f2-r2c4. These types of photoelectric sensors are from a large catalog of different types. Some AC some DC powered. Different reaches, etc...
See resources in this git repository for some PDFs.

I tested one but had poor results. I was only able to get the light to flash when I dismantled the device. Teardown pictures are in the photos folder. Here's an example. The devices were not easy to dismantle, and can't really be put back together as well as they were originally. However, they did seem otherwise well made. More testing will be needed on these.

An example of a low cost photo electric sensor from ebay.

Testing Attempt #2

After finding some documentation on these in the reviews, I figured out why it wasn't working for me. These opto electronics absolutely require some type of reflector opposite them. Now, not all photoelectric sensors are like this, but this omrom model is. I've also purchased low cost ebay photoelectric sensors in the past, and those require no kind of reflector. Here is the review which details how to use the Omroms:

> *Good quality product. It has reverse polarity protection, etc. This has the emitter and receiver built-in. Best to use a retroreflector like a bicycle reflector or retroreflector tape. The indicator light will come on to show the state. The logic output is open collector and you'll get whatever the supply voltage is. To use with 5v ttl (using a second 5v source) wire as such:*
>
> *Brown to +12V; Blue to ground; Pink to either +12 or ground depending whether you want Light-ON or Dark-ON mode;*
>
> *Black to a 4.7K resistor with the other side of the resistor connected to a separate +5V source (the arduino). The 5v ttl signal is at the point where the black wire connects to the resistor.*

After trying with a component bag, which is slightly reflective, I was able to find a point where the emitter was consistently able to get a high result. This comment also tells you where to obtain the TTL

signal, we need for a micro to register a high. Therefore, I purchased some reflective stickers available from all electronics, as well as some iron-on reflective material from ebay. I will test both of these out next.

One thing I also noticed, was that used photo electric sensors from brand names can be obtained for discounts on the auction site. I saw a sick motion sensor for $10. It may be wise in the future to look at auction sites, to see if a good deal can be had.