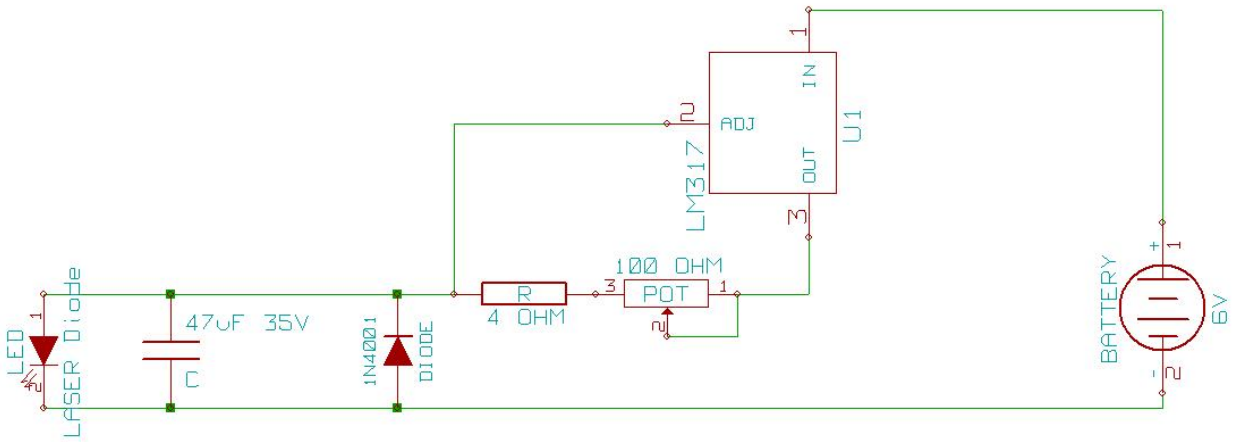
Physical Programming

CNC Laser Cutter - Partial Work

The basic concept behind the laser cutter was to have a DVD burner diode running at approximately 200mW scooting about an XY table being driven by two stepper motors (also borrowed from broken DVD drives).

The basic plan was as follows,

On the hardware side the design was to have the two steppers were going to be driven by stepper motor controllers, which were controlled by the Arduino. The laser diode would be powered by a voltage limiting driver circuit, switched on and off by a MOSFET driven by one of the Arduino's digital pins.



The laser driver circuit.

On the software side the plan was as follows... Given that any raster image is essentially just a
two dimensional array of pixel values my idea was to write a program that would read each non-white pixel value, output its X and Y co-ordinates relative to the last pixel outputted, and then output the grey scale value of that pixel as a time value to the pin controlling the laser driver. The darker the pixel's greyscale value, the longer the laser's turned on.

My (very rough) pseudo-code for this mess might look something like this. It attempts to call functions that are in line with what's possible in processing, as such the image is imported into a one dimensional array. Similarly I've called the "width" and "height" variables as they are available in the processing environment. The "PRINT" function is used to show where data would be exported to the Arduino to be passed on to the stepper motor controllers and the laser driver.

START

float delayconstant = 5 //To allow for fine tuning of the laser's timing for different materials

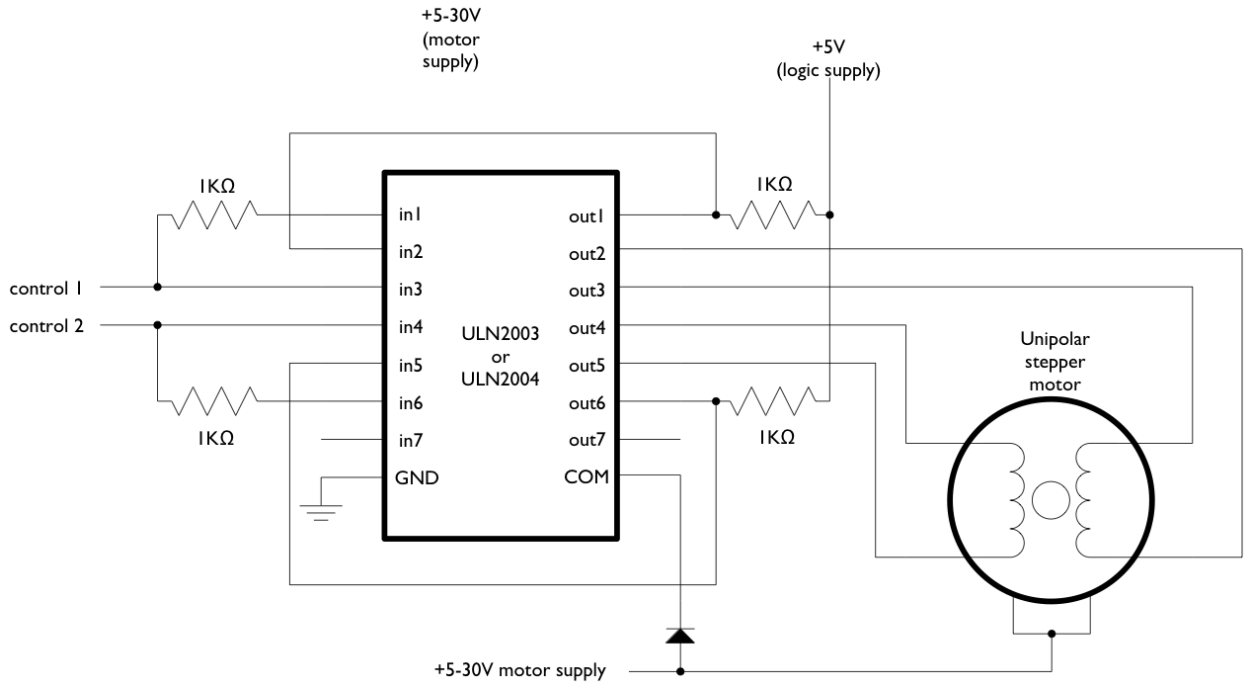
```
int x = 0                                   //A variable to store the laser's current x
position
int y = 0                                   //A variable to store the laser's current y
position
int xinc = 0        //Outputted to the x axis stepper motor to move from the last pixel to the
next
int yinc = 0        //Outputted to the y axis stepper motor to move from the last pixel to the
next
int i = 0                                                                   //Loop index
int[] = array[]                         //One dimensional array that stores the image's
pixels
int darkness = 0                //Variable to store the greyscale value of the pixel being
processed

Import image = array

for i from 0 to (width * height) by 1
    if array[i] ≠ 'white'
        yinc = (i / height) - y
        xinc = (i - (y * height)) - x
        darkness = delayconstant * array[i]
        PRINT(xinc, yinc, darkness)
        y = i / height
        x = i - (y * height);
    else;
;

*END*
```

The Arduino website has stepper motor libraries with tutorials for working with stepper motors through ULN2003 stepper controllers.

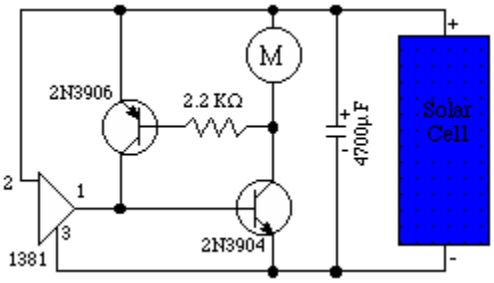


Finding these circuits and sorting out the logic behind my code was as far as I really got with this project. I collected two DVD burners and extracted the diodes, only to find that I killed one just by prying it free and the other by testing it on two fully charged NiMH batteries, which I discovered after the fact can deliver a voltage surge when they're first hooked up to something. Time and cost (the limiting factors in any project) prevented any further exploration and I decided to cut my losses and move on to another project.

BEAM Bot Dew Harvester

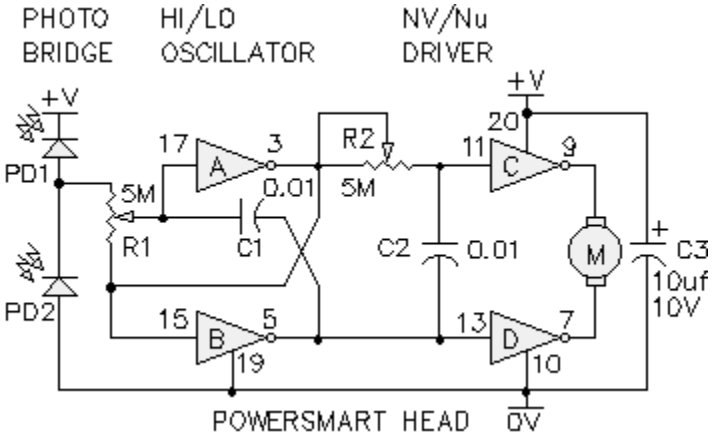
The Dew Harvester is an adaption of a few BEAM circuits to use a solar cell to run a peltier element so that it gets cold enough to condense water from the atmosphere, with a view to watering plants in arid conditions.

The circuit has three elements, a solar engine,



to collect and store the energy from the solar cell until it reaches a usable quantity.

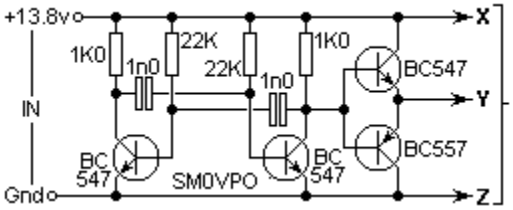
A tracking head



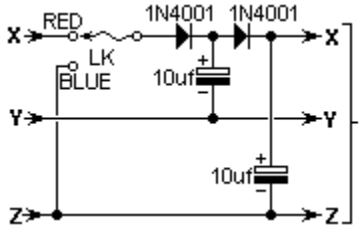
to keep the solar cell pointed at the brightest source of light it can "see"

And a peltier element.

A peltier element is a semiconductor heat pump. When DC voltage is applied one side gets hot, the other cold. The element is wired to come on at the same time as the tracking head circuit, which is driven off the solar engine like this;



Voltage Multiplier Circuit Base



Stages to Add Iterations of Max Voltage

Despite getting the tracking head to work, I discovered that the peltier element I'd bought from Jaycar had a different voltage rating to what I'd been told. To get around this the final design will need a voltage multiplier of some kind to get the temperature difference needed to actually precipitate dew.