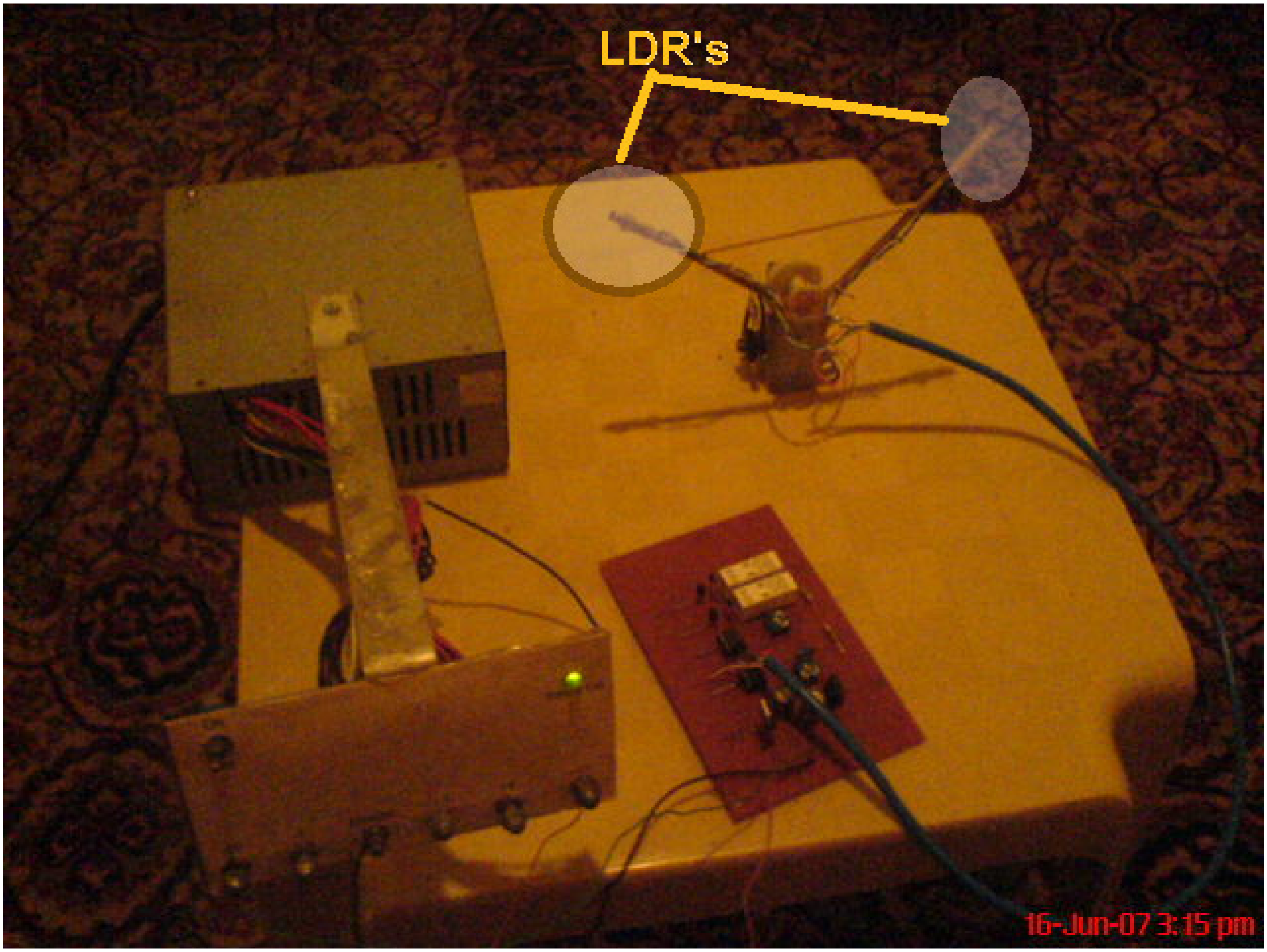


(My PC power supply, the circuit and the motor holding the two LDR's)

(Posting this file on the discussion board was impossible….so decided to make it a pdf file that could be easily saved)

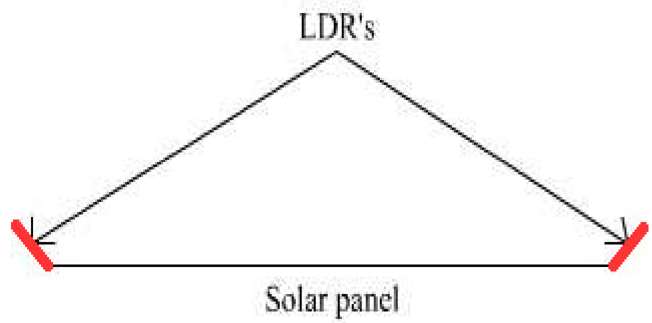
Hi all….

Few weeks ago, I was googling for solar trackers and found many systems that are very complex… (microcontrollers and stuff)…and others that are easy enough but can go crazy if it's cloudy …or can't rotate backwards (towards east) except when it's totally dark (night); although it should have the ability to rotate towards the east (IMHO) just in case there was false triggering and the solar panel rotated towards the west more than it should.

Thinking about it over and over again, I came up with a design that it is very simple and can be constructed by anyone who has a very basic knowledge of electronics ….

(it turned out it wasn't me alone who got that idea ☺ I searched over the net for something similar and found that other ppl came up with almost the same design)..

How it works



Two light-dependent-resistors are placed on each side (of the solar panel to track the sun) in a way that when the panel is directly facing the sun, they will be getting equal amounts of light. I put each of them at 45 degrees from the solar panel.

In theory, when identical LDR's get the same amount of light, they will have the same resistance….so when you apply a voltage across these two LDR's connected in series, they will have the same voltage according to voltage divider principle.

When the sun moves towards the west… the west LDR will get more light, meaning that it's resistance, and hence voltage, will decrease (LDR's resistance is low when it is exposed to light and high when it's dark).

If for any reason the solar panel has moved to the west more than it should, the east LDR will get more light.

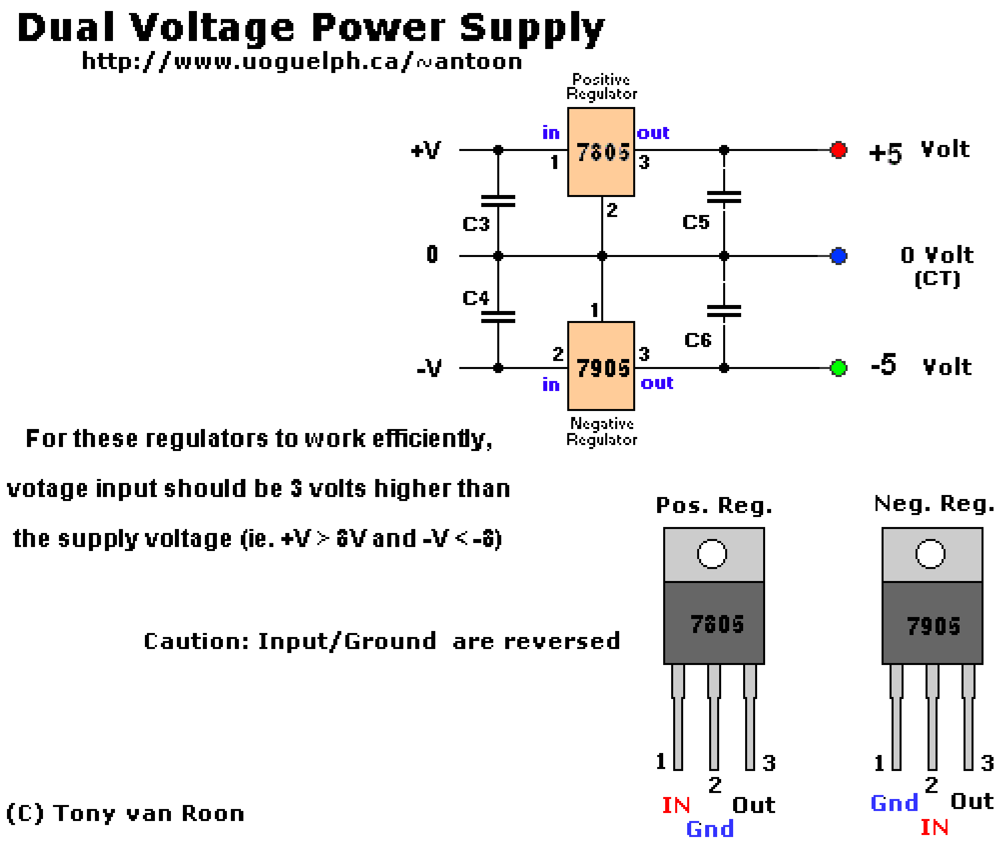
The idea is to simply compare the two voltages of the LDR's, hence decide which one has more light falling on it, and then rotate the solar panel towards it. This is achieved by using an operational amplifier. (two actually…I'll get to that later.)

To those who don't know, an operational amplifier has 2 inputs V+ and V-. When V+ > V- the output will be a positive voltage, when V+ < V- the output will be a negative voltage (in case we supply the opamp with Vcc & -Vcc as in my project….. I used +5 and -5)

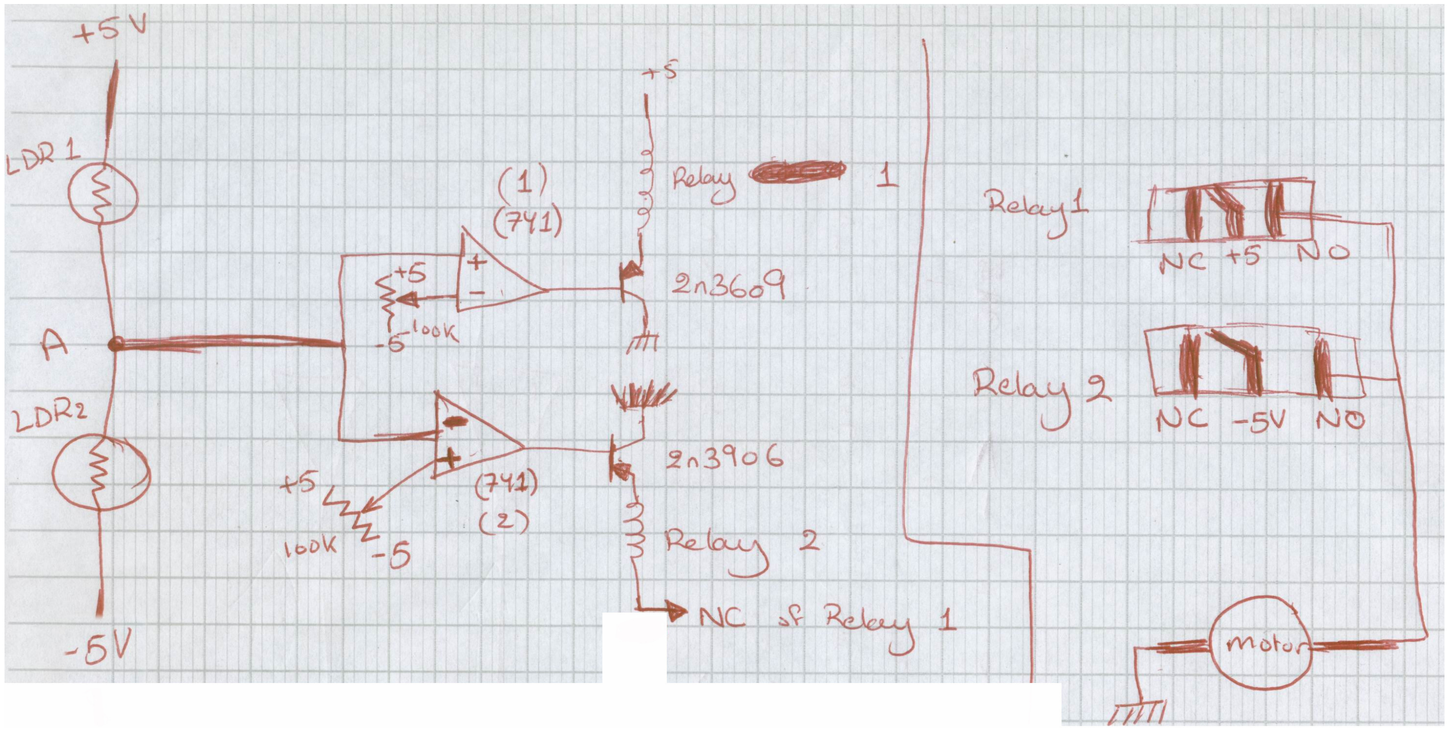
Voltage supply

For proper operation of the circuit, we need a constant voltage supply since we are depending on voltage comparison…..

To get a constant voltage, I used the 7805 and 7905 positive and negative voltage regulators.



Schematic



Since it is hard to get two totally identical LDR's, we have to know what will be the **voltage at point A when the two LDR's get the same amount of light**; I'll call that voltage **V (equivalence).** What I did was working in a room where the only source of light was a lamp. I positioned the LDR's in a way to get the same amount of light and then measured the voltage at point A. (All measurements are done with respect to ground or 0 volts of course). V- of 1st opamp and V+ of 2nd opamp are set using the potentiometers.

V- of the first opamp is set to a slightly more negative value than V (equivalence).

V+ of the second opamp is set to a slightly more positive value than V (equivalence).

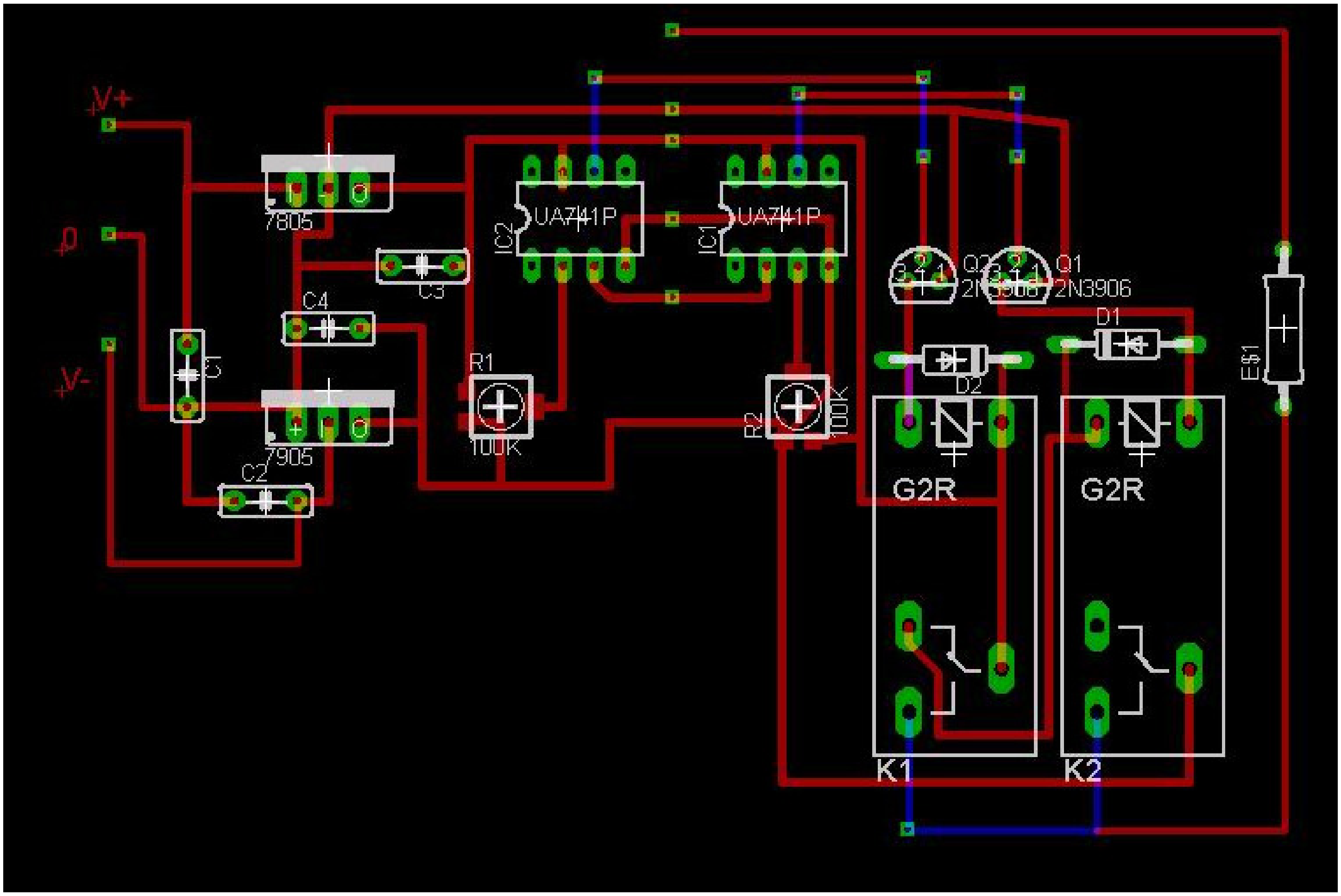
In my circuit Vequivalence = -2.1 V   I set   V- (1st opamp) to -2.4 V

V+ (2nd opamp) to -1.75

When V (A) is lower than V- of 1st opamp, the output of the 1st opamp will be negative and the PNP transistor will conduct, thus relay 1 is activated and +5 volts is applied to the motor. The motor should rotate then towards the LDR with more light. When it gets to equilibrium, V (A) will be higher than V-, then the relay is deactivated and the motor will stop. This will also apply +5 volts to the coil of relay 2.

When V(A) is higher than V+ of 2nd opamp, the output of the 2nd opamp will be negative and the PNP transistor will conduct, thus relay 2 is activated (in case relay one is deactivated) and the motor will rotate in the opposite position of the first case. Once again, at equilibrium, relay 2 is deactivated and the motor will stop. Between V- and V+, both relays are off….this will give some hysteresis to the system so that the motor doesn't keep on rotating back and forth.

Board Layout



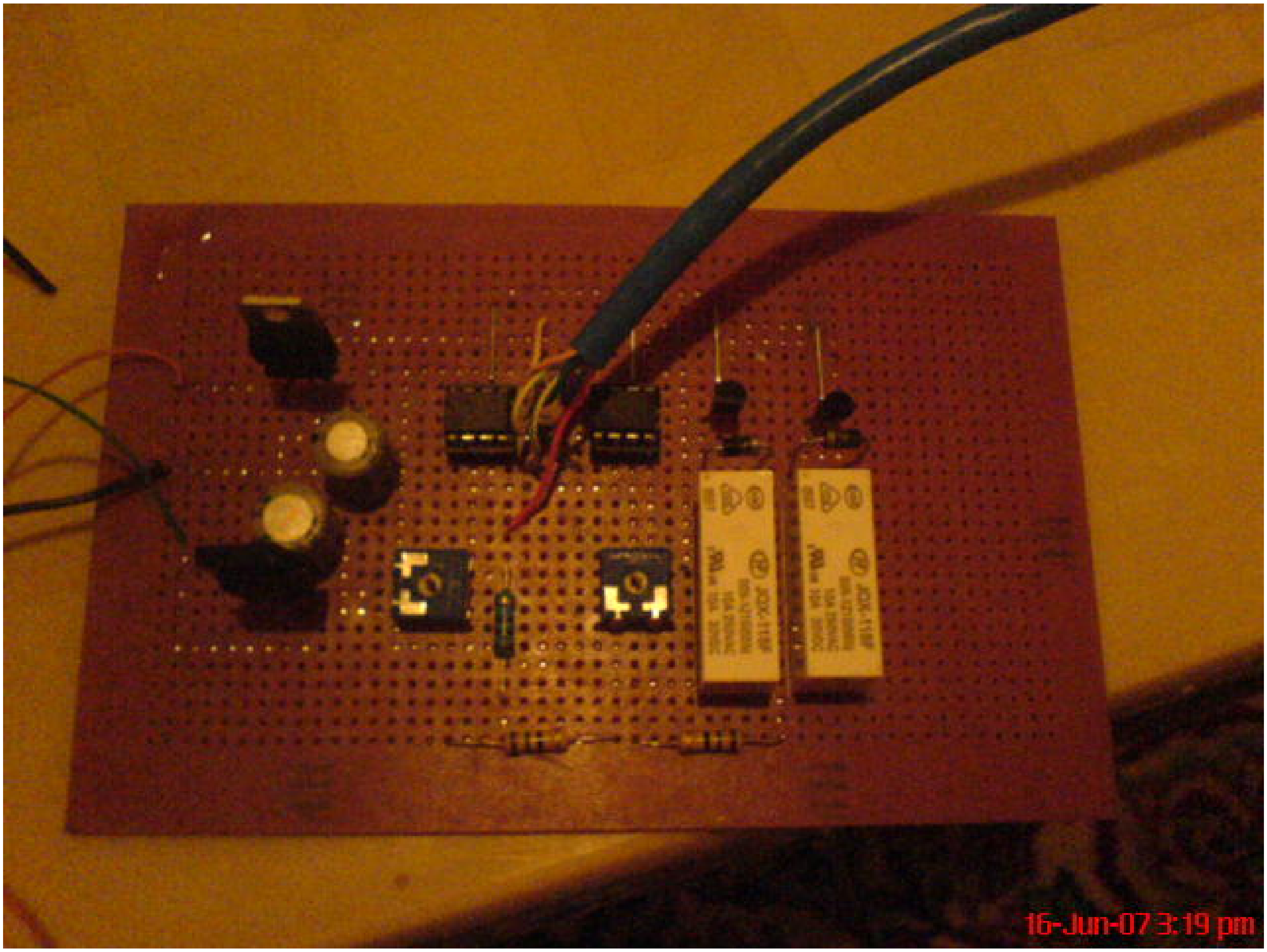
The coil of relay 2 is supplied with +5V from the "normally closed" contact of relay 1 to insure that both relays can't be turned on at the same time and thus short circuiting +5V to -5V.

(The five green holes between the two opamps are used to connect the two LDR's to +5 V and -5 V and the output from the relays and ground to the motor).

The two diodes are used to avoid any spikes and back emf (i.e. protect the transistors)

The resistor to the right is used to limit the voltage supplied to the motor just in case motor if faster than it should be.

This my completed circuit below



Why two opamps??

I used two opamps to be able to totally control west and east sensitivity INDEPENDANTELY. I first made the circuit with one opamp but got a hard time calibrating it and there wasn’t enough hysteresis so the motor kept on oscillating once it got to the theoretical equilibrium position.

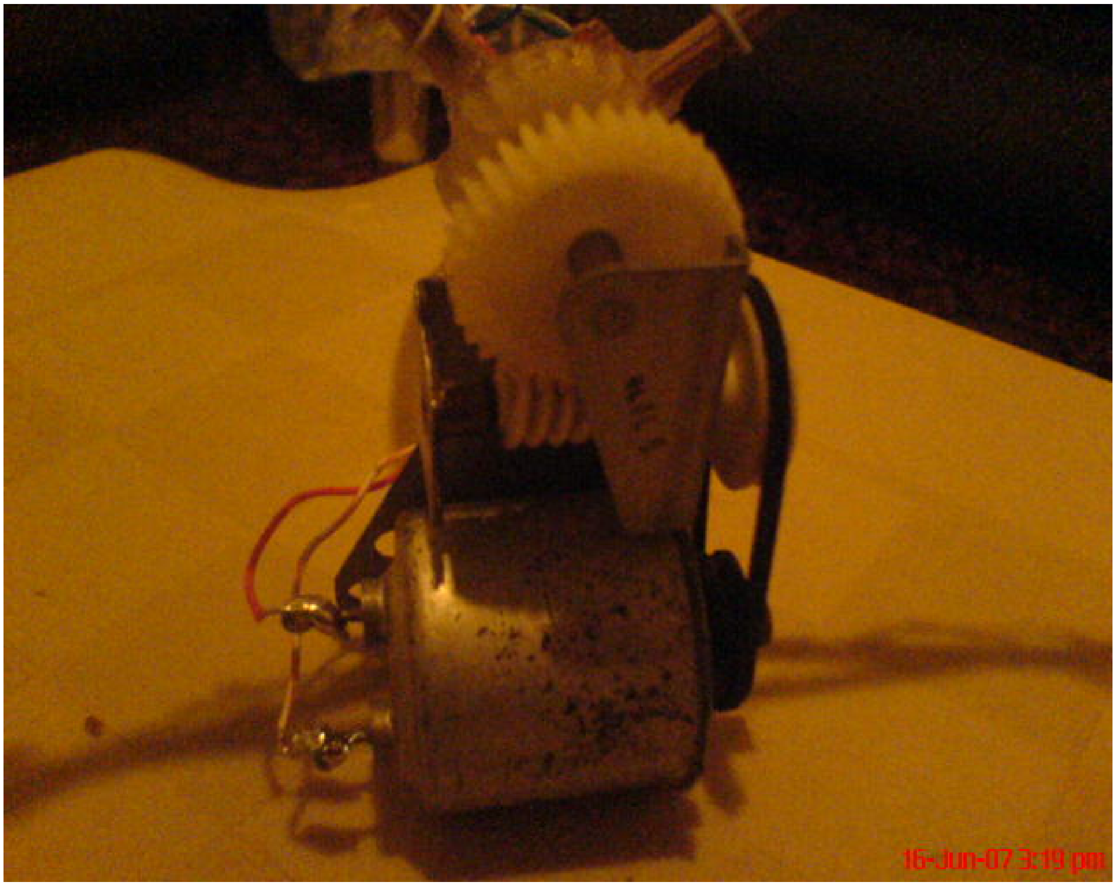
Why relays??

I used relays to control the motor and not transistor because a relay can conduct much more current than transistors (unless you get big power transistors)…this way you don’t have to worry about the power of the motor you’re using.

Motor

I advise you to use the slowest motor you can find since this will let the system work smoother.

There SHOULD be a gear that doesn't allow the solar panel to rotate the motor. Something like this gear (screw gear). When the screw is rotated by the motor, it rotates the gear above it….but if the weight of the solar panel tries to rotate the above gear, the latter will push axially on the screw and thus it won't move.



All's finished, what's next??

After everything is done, you can check your tracker by putting your hand around one LDR. The motor should rotate towards the other LDR (the motor should rotate towards the LDR getting more light). If the motor rotates in the opposite direction, simply reverse the connections on the motor.

You're tracker will work fine with a system like this one, but it would be better if you use two of these trackers for one solar panel: the east-west tracker and the north-south tracker because with only one tracker, your panel is centered for east-west directions, but not centered for north-south directions.

After the sun is down

I'm planning to use another circuit along with this one; it's actually a small modification of the automatic night lights. When this circuit senses that it is dark, it will deactivate the tracker's circuit, and give a 2 or 3 seconds pulse to the motor to rotate it eastward…..why?? because if I don't do that, at the next sunrise light MIGHT fall equally on the two LDR's since both of them are facing west.

Any comments or questions are welcome…

Imad Mwaffac