

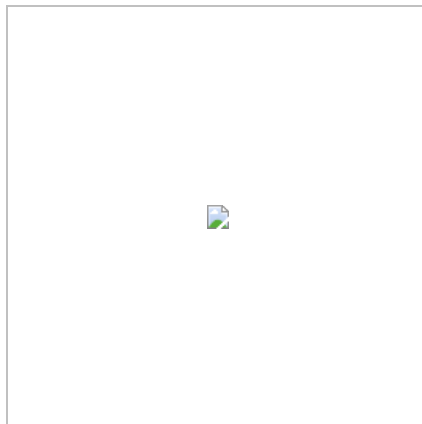


Nov 13 Sharp Dust Sensor and Arduino

Paul
Comments

Arduino, Sensor
air quality, analog, Arduino, dust, pwm, sharp 42

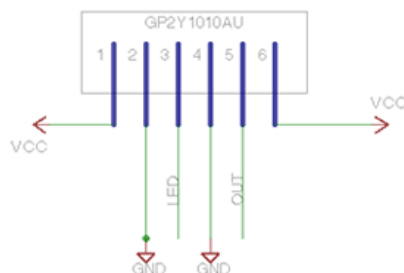
Sharp's GP2Y1010AU0F is an optical air quality sensor, designed to sense dust particles. An infrared emitting diode and a phototransistor are diagonally arranged into this device, to allow it to detect the reflected light of dust in air. It is especially effective in detecting very fine particles like cigarette smoke, and is commonly used in air purifier systems.



The sensor has a very low current consumption (20mA max, 11mA typical), and can be powered with up to 7VDC. The output of the sensor is an analog voltage proportional to the measured dust density, with a sensitivity of 0.5V/0.1mg/m3.

This is how the optical dust sensor works:

According to the [GP2Y1010AU0F data sheet](#), all 6 pins on sensor need to be connected to Arduino:



Gadgets powered by Google

pdeng@sensorapp.net

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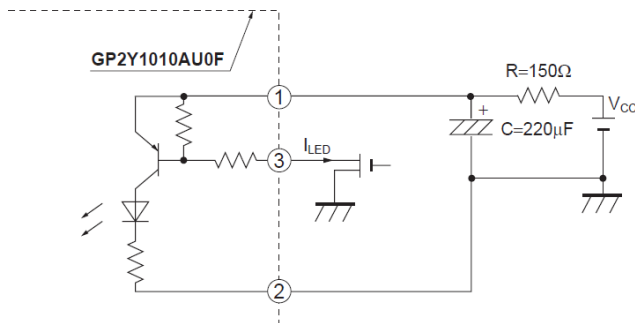
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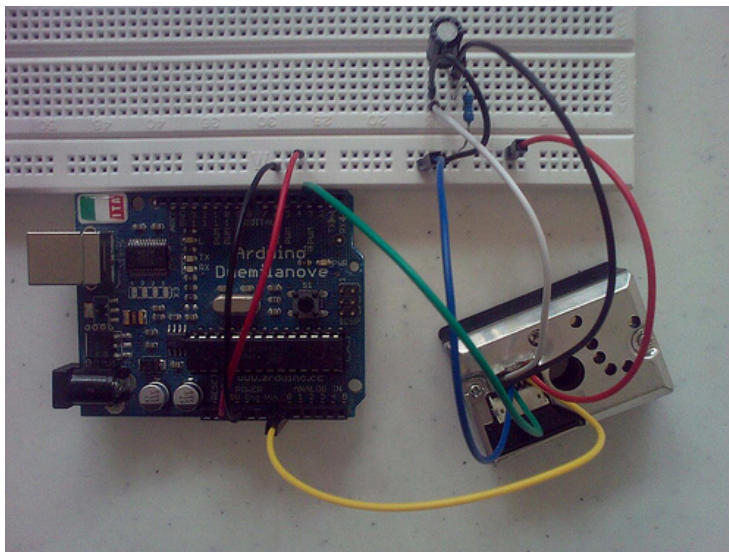
Do not miss the 150ohm resistor and a 220uF capacitor:



Sensor Pin	Arduino Pin
1 Vled	→ 5V (150ohm resistor)
2 LED-GND	→ GND
3 LED	→ Digital pin 2
4 S-GND	→ GND
5 Vo	→ Analog pin 0
6 Vcc	→ 5V

The LED pin has to be modulated with a cycle of 1ms as discussed in the datasheet. The LED seems to use a PNP transistor so to power on, the LED pin must actually receive a lower voltage.

Ok, you should now have every thing connected:



The Arduino source code:

```
01  int dustPin=0;
02  int dustVal=0;
03
04  int ledPower=2;
05  int delayTime=280;
06  int delayTime2=40;
07  float offTime=9680;
08  void setup(){
09    Serial.begin(9600);
10    pinMode(ledPower,OUTPUT);
11    pinMode(4, OUTPUT);
12  }
13
14  void loop(){
15    // ledPower is any digital pin on the arduino connected to
16    digitalWrite(ledPower,LOW); // power on the LED
17    delayMicroseconds(delayTime);
18    dustVal=analogRead(dustPin); // read the dust value via pir
19    delayMicroseconds(delayTime2);
20    digitalWrite(ledPower,HIGH); // turn the LED off
21    delayMicroseconds(offTime);
22  }
```

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```
23 | delay(3000);  
24 | Serial.println(dustVal);  
25 | }
```



Reference:

<http://www.staceyk.org/airSensors/sensorsetup.php>
<http://itp.nyu.edu/physcomp/sensors/uploads/arduino.txt>
<http://itp.nyu.edu/physcomp/sensors/Reports/GP2Y1010AU>

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42 Comments *(+add yours?)*



Jarrod

Nov 29, 2010 @ 13:38:55

Thanks, great no-nonsense tutorial



brian

Dec 03, 2010 @ 10:42:16

why can't they make one with the light receptor directly across the LED and just transduce the light intensity to voltage? That's simpler i guess, and you can measure things beyond dust.



Gene

Apr 12, 2012 @ 00:00:09

I just received one, wired it up as shown and ran the code also as shown. While sealed in an antistatic bag I'm showing random readings with about 10 zeros, then 29, then 5 more zeros, then a 45, a few more zeros, a 9 etc. Since there is only a short pulse these numbers don't sound right at all. It's not noise on my arduino as just looking at the sensor output it jumps around. Has anyone actually made this work?

I have done a lot of searching and this and one more examples are all I've found.

I would like to hear from someone that experienced good results with this sensor.

Gene



tbitson

Jun 24, 2012 @ 12:01:58

Any idea what the 150 ohm resistor does? Power supply filtering?



Matt

Aug 08, 2012 @ 18:02:56

Hey Gene,

I did some work with the sensors and it seems to me that your sensor may be broken. In my first experiments, I think I fried the LED of one of my sensors and afterwards it showed a similar response to what you described. Hope that helps...

Matt



Dusty

Sep 06, 2012 @ 03:49:01

Hey Gene,

I got the same results before I hooked up a 220uF capacitor between VLed and Gnd.

However, after I plugged in the capacitor between pin 1(VLed) and ground, the sensor seemed to work just fine.



Vincenzo Cocca

Sep 24, 2012 @ 19:34:25

Good morning. Could You help me to calibrate this sensor? Thank you very much.

Vincenzo



Paul

Nov 01, 2012 @ 08:59:25

Hi Vincenzo,

It is not a very accurate sensor. I do not think calibrate it will somehow make it work better.

Cheers,
Paul

[#IPSOChallenge #IoT](http://newsmanager.commpartners.com/ieee/#IPSOChallenge)

Thursday from Twitter - Comment

Embedded wireless that delivers flexibility and lower costs is a no brainer for the future of networked LEDs.

<https://www.greentechmedia.com/article...>

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**Vincenzo Cocca**

Nov 05, 2012 @ 21:39:07

Thank you Paul. Does it required periodic recalibration of this sensor? Or no?

Thank you
Vincenzo

**kyle**

Nov 06, 2012 @ 16:04:02

what's the voltage on the 220uF Capacitor?

**Evgeny**

Nov 07, 2012 @ 15:19:15

For this example, any more than 5 volts (example 220uF 25v)

**A different kyle**

Dec 05, 2012 @ 11:04:18

I'm a bit confused regarding the role of the capacitor.

When i assemble the circuit without it, i get analog results ranging from 0 – 765 using the sample Arduino sketch provided.

When i add the capacitor to the circuit, the base value moves to ~200. And the sample range is (~200 – 765).

In the latter case, i am no longer able to achieve "near-zero" values. Which i assume is wrong.

I have spent considerable time checking the wire-up of the circuit, so im pretty sure that's not the issue.

Any suggestions would be appreciated!

**Nicholas**

Jan 19, 2013 @ 03:21:03

Hey guys,

Just a thought that you're probably going to want to calibrate the sensor for temperature and humidity if you want it to work correctly.

**Shashi Maurya**

Jan 23, 2013 @ 01:29:01

Hello everyone!

I have no background in electronics. I'd like to know after logging the voltage output from the sensor, what is the unit for the dust density?

Thanks.

**Vincenzo Cocca**

Jan 25, 2013 @ 00:51:21

Hi Shashi,
dust density is in mg/m3.

**Vincenzo Cocca**

Jan 25, 2013 @ 01:43:57

Good afternoon to everyone.

I have a problem with this sensor. I read an erratic value of dust density. I think the dust is adhered to the inside of sensor. On datasheet it is written that I must consider the maintenance such as vacuuming. Could you say me more information about it?

**hozone**

Jan 31, 2013 @ 20:35:46

hello,

i'm experimenting too with GP2Y1010AU0F, but i've found a strange behaviour.

my sensor is connected like datasheet explain, pin 3 direct to atmega (i've also try using a mosfet but it do not change)

if i run GP2Y1010AU0F with 5.330 voltage i read an output voltage between 0.800 and 0.850

if i run GP2Y1010AU0F with 5.080 voltage i read an output voltage between 0.770 and 0.830

if i run GP2Y1010AU0F with 4.670 voltage i read an output voltage between 0.700 to 0.770

so there's a small drift when supply voltage change.

i suppose the fig 3 of datasheet, from which we can extract slope and offset to find dust sensity, it's 5.0v supply voltage, so reading an "incorrect" voltage would bring to incorrect mg/m³ conversion.

have you also find this behavior?

have you find a way to balance the supply voltage drift?

thanks all



Vincenzo Cocca

Feb 01, 2013 @ 19:41:40

Hi hozone. I don't find this behavior because I use this sensor by Libelium system (www.libelium.com) and I don't know exact value of supply voltage. Sorry.

hello



HooverTeam

Feb 22, 2013 @ 21:46:19

Hello everybody,

We are a group of students that will try to make this sensor work on a vacuum cleaner. Can someone tell us if this is going to work or is it too sensitive to be able to send valid data from such a strong airflow as the one resulting from a hoover's activity?

Thank you all in advance.



kim

Feb 26, 2013 @ 15:09:29

Hi all,

Does anyone know whether this sensor can detect PM 2.5 particles. I have read the datasheet and it only mentioned about the density sensitivity, so what about the size sensitivity?

Thanks all



Vincenzo Cocca

Mar 01, 2013 @ 00:09:13

Hi Kim. This sensor detects PM2.5 particles.



xocapick

Mar 04, 2013 @ 22:39:42

Hi all..

I have a question...

What exactly range voltage between having no dust, and lot off dust.. Because in the datasheet they say that Output voltage range is 3,4 min, and do not say anything about the max.. and the graphic isn't clear ...

Best regrats



kim

Mar 07, 2013 @ 14:05:59

Thank you for your reply Vincenzo,

If i just want to detect particles that are smaller than PM2.5 do you think it will work if i place a PM2.5 filter paper at the air intake. What would you recommend.

Thanks.



kim

Mar 09, 2013 @ 20:40:57

Hi all,

I'm confused as to how this sensor's sensitivity is measured. From what i understand, it uses the particle scattering method to detect dust. However how is the sensitivity units in density and not pieces or particles per liter (psc/L). How can you detect the weight of dust through this optical method.

Can someone please shed some light.

Thanks.



Vincenzo Cocca

Mar 20, 2013 @ 23:31:22

Hi kim.

I know that there aren't PM2.5 filter. Only cyclone or impactor.

Then, this sensor doesn't count number of particles but only their mass. There is a relation between ppm and mg/m³. Let you see on web.

Bye



Alex



Mar 29, 2013 @ 08:44:37

Hello

Can anybody say what is the role of the capacitor of 220uF?

I tested the sensor i l obtained a strange behavior without the capacitor (i don't have it in this moment). The values obtained are: 10 10 10 120 10 10 10 10. The maximum value is 1000. Are the values correct ? for example 10 means no dust?

Can the sensor be used as a fog detector? In my tests i observed that when the humidity is high (as in the case of fog) the detected values are higher.
thanks.



Ken

Mar 31, 2013 @ 06:35:36

I am trying to set this up for the first time. How is everyone doing the wire connection to the sensor? Did you get a connector for the 6-pin connector or did you somehow just wire it in? I am not familiar with such fine wiring as the connector is quite small. Thanks.



Paul

Apr 02, 2013 @ 09:46:00

Hi Ken,

Connector is tiny, it is even harder than soldering wires direct on to the pins.

Connector can be found here <https://www.sparkfun.com/products/9690>

Cheers,
Paul



Chris

Jun 07, 2013 @ 10:26:10

This may be of help. If you multiply the sensor output by .0049, you get the voltage reading from the analog pin. If you're a rookie to Arduino like I am, that could save you some time. Voltage = analog output * 0.0049.

I got that from this Arduino reference page:
<http://arduino.cc/en/Reference/AnalogRead>.



Joe

Aug 20, 2013 @ 04:05:11

Comparing the photo to the schematic, they don't seem to agree. According to the schematic, Pin 2 should connect to the other side of the capacitor, no? This isn't the case in the photo.



SpikeyB

Sep 06, 2013 @ 23:23:11

This sensor works similar to optical smoke alarms. The 150R resistor charges up the 220uF cap, the FET discharges the capacitor into the IR emitter and the output from IR diode is read while this high current is flowing. The FET is then turned off and the capacitor is allowed to charge again. Leaving the current flowing through the emitter will not give good results.

The best way to get a result is to measure the voltage just before the current is switched on and then a millisecond after the current is flowing and then subtract one from the other to give a reading. This will offset the 'dark reading so minimising temperature effects.



Anonymous

Sep 07, 2013 @ 19:18:42

Can I use the sensor to measure the average size and concentration of the dust particle simultaneously?



Bashir

Sep 07, 2013 @ 19:21:23

I want to know if the dust sensor can be used to monitor dust particle sizes and concentration in real time. Please I need your help, I need to if it solve my problem before I buy it.
Thanks.



YZ

Sep 09, 2013 @ 12:11:41

Bashir, yes only the real time concentration part is possible, i don't know whether you can tell the particles measured are pm10 or pm2.5.

Ok so i got this sensor to work, i have tried fanning cigarette smoke to the sensor and seeing the output rise and drop according to the amount of smoke. Another test I've done

is to measure PM10 levels in outdoor air, I am located 500 meters for a EPA station that measures and displays PM10 levels on their website. After having left 2 sensors outdoor for a whole day what I've found is that having had a max level of 30ug/m³ of PM10 during that period the sensors output had not changed, all I've recorded for that whole day was a flat line of noise. Similar observation was seen when i was mowing the lawn i had 3 sensor placed on a table right next to the grass. I was hoping it would measure some sort of change due to changes in pollen levels because i was sneezing heaps. The last test I've ran was when i was deep frying some fish and had a couple of sensors place in the kitchen, again no changes were detected.

From what I've found, for this sensor to be in its operating range the quality of the air must be bad enough that it will be easily noticeable by our senses.
Is there something that i am doing wrong here, is it really that insensitive?

Has anyone had any success measuring PM10 under 30ug/m³ of density. What are the range of density values that people had their sensors to react.
What other areas do people think this sensor will be good for.

Thanks.



Wayne Thayer

Nov 07, 2013 @ 13:39:45

Paul-

Thanks for your postings. I have just completed some long term experiments with this sensor.

I paired it with a Honeywell 6130 temperature/humidity sensor, which was nice to have because there was a mild temperature coefficient for the dust sensor which I was able to remove.

The first problem is that the output is unfiltered and the sensor output depends on the rate you read it. Not so surprising when you realize that big 220uF cap voltage will drop significantly while flashing the LED on. It gives most consistent results when run at the maximum rates and duty cycle suggested in the Sharp data sheet. But the output will still be highly erratic. I found a simple recursive filter with a 10 second time constant made the resulting data very consistent and useful.

Used this way, the sensor is quite sensitive and will detect particle concentrations below any visual threshold. But I can't say whether this is good enough to accurately measure pollen levels. I ran it one night a week over the summer and was able to see baseline variations consistent with pollen levels. I got this because I wanted to see if my property was being fumigated by our county mosquito control crew. It detects the aerosol cloud they put out pretty well.

I also believe I have a calibration system rigged up well enough that I should be able to detect the consistency of the sensor: I vaporize a controlled amount of propylene glycol in a sealed 5 gallon bucket, and watch the sensor response. Three consecutive readings were within around 5%, which is as good as I can expect.

To "harden" the sensor for outdoor use, I put it into a large plastic tube with screens on both ends (often bugs like even very small amounts of IR light!). Then a fan was needed to assure sufficient air circulation to get a representative sample.



John

Nov 22, 2013 @ 15:14:24

- Wayne

HELP PLEASE!

How on earth do I get this thing to work on a Raspberry PI?

I have been messing with this sensor for months but I can't get it to give anything but a noisy erratic chart that corresponds to nothing.

My circuit is exactly as shown above and I have used the ms reading times as shown in the code but in python.

You say that you used a 10 second recursive filter.. what is that? Software or hardware something? Can you explain for an idiot please.
Did you modify your circuit from what is shown above?

I really want to get this thing working on the PI!
Please help!!



Christian Rapp

Dec 14, 2013 @ 22:35:03

Wayne Thayer:

Could you please share your data about the temperature coefficient? I've also set up an outdoor device with a fan. It also be nice if you could show your algorithm to reduce noise.

Thank you very much!



Dok O Caoimh

Feb 15, 2014 @ 06:59:27

Using the setup and code I am getting output values in the range of 200 to 300.

It is not 200mg/m3 or is it? This seems way too high for an office building.

If these values seem wrong can anyone point me in the right direction to work out what I am doing wrong? If they are right can someone tell what the equivalent ppm should be?

I am using an Arduino Uno. Here is a link to a pic of this setup:

https://drive.google.com/file/d/0B40h_rMT8H6qUzFZVjhYMWljVzQ/edit?usp=sharing

Also. I have minimal electronics experience and this is my first try with an Arduino (after running a couple of simple tutorials with LEDs).



Dok O Caoimh

Feb 21, 2014 @ 05:39:00

Also, the maximum reading I get out of it no matter what environment it is in is 759?

For example when I blow thick smoke through it.



Hansen

Feb 24, 2014 @ 20:14:15

My bad was pulsing it at 32us instead of 320us. Its working now



Fabrizio

Mar 06, 2014 @ 03:39:29

I do not understand in your Arduino sketch the following line:

```
pinMode(4, OUTPUT);
```

Could you please give me some help ?

thanks



Alex

Mar 07, 2014 @ 00:45:02

Hi, I have been experimenting with a very similar setup using the Sharp dust sensor for an Undergraduate Major Project.

The nature of the project would ideally have the scale of the sensor reduced to improve wearability. Speaking theoretically, if the depth (18mm) of the device/housing were to be reduced and the device be recalibrated could similar results be achieved in the smaller housing?

Also this appears to be the smallest commercially available dust/particulate sensor available, unless anybody knows of an alternative?

Thanks

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