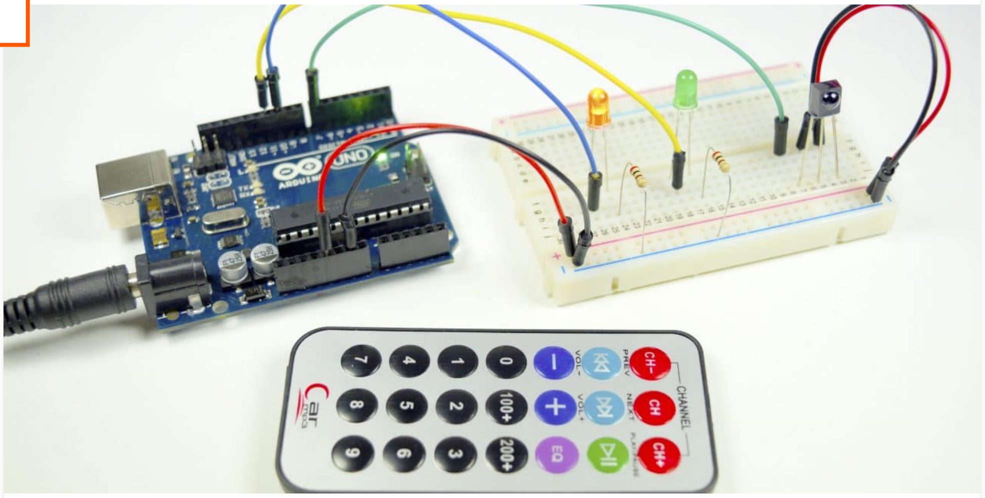
HOW TO SET UP AN IR REMOTE AND RECEIVER ON AN ARDUINO

Posted by Krishna Pattabiraman | Arduino | 24



Infrared (IR) communication is a widely used and easy to implement wireless technology that has many useful applications. The most prominent examples in day to day life are TV/video remote controls, motion sensors, and infrared thermometers.

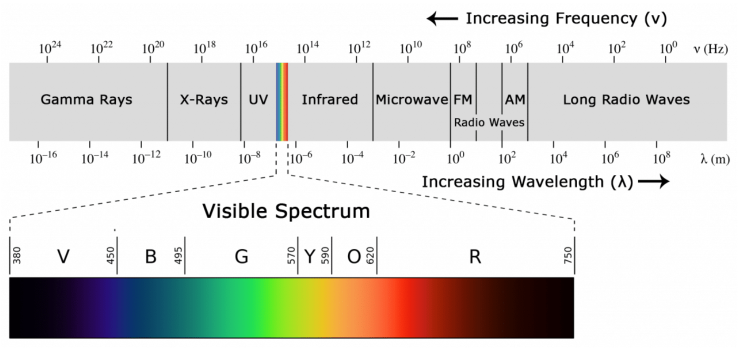
There are plenty of interesting Arduino projects that use IR communication too. With a simple IR transmitter and receiver, you can make remote controlled robots, distance sensors, heart rate monitors, DSLR camera remote controls, TV remote controls, and lots more.

In this tutorial I'll first explain what infrared is and how it works. Then I'll show you how to set up an IR receiver and remote on an Arduino. I'll also show you how to use virtually any IR remote (like the one for your TV) to control things connected to the Arduino.

Now let's get into the details…

WHAT IS INFRARED?

Infrared radiation is a form of light similar to the light we see all around us. The only difference between IR light and visible light is the frequency and wavelength. Infrared radiation lies outside the range of visible light, so humans can't see it:


← Increasing Frequency (ν)
10^24 10^22 10^20 10^18 10^16 10^14 10^12 10^10 10^8 10^6 10^4 10^2 10^0 ν (Hz)
Gamma Rays
X-Rays
UV
Infrared
Microwave
FM
AM
Radio Waves
Long Radio Waves
10^-16 10^-14 10^-12 10^-10 10^-8 10^-6 10^-4 10^-2 10^0 10^2 10^4 10^6 10^8 λ (m)
Increasing Wavelength (λ) →
Visible Spectrum
380 V 450 B 495 G 570 Y 590 O 620 R 750

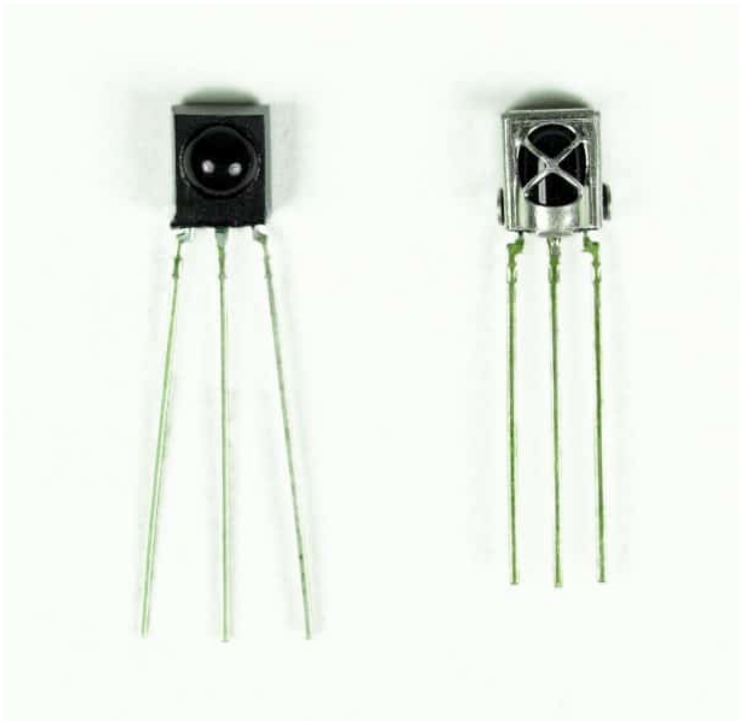
Because IR is a type of light, IR communication requires a direct line of sight from the receiver to the transmitter. It can't transmit through walls or other materials like WiFi or Bluetooth.

HOW IR REMOTES AND RECEIVERS WORK

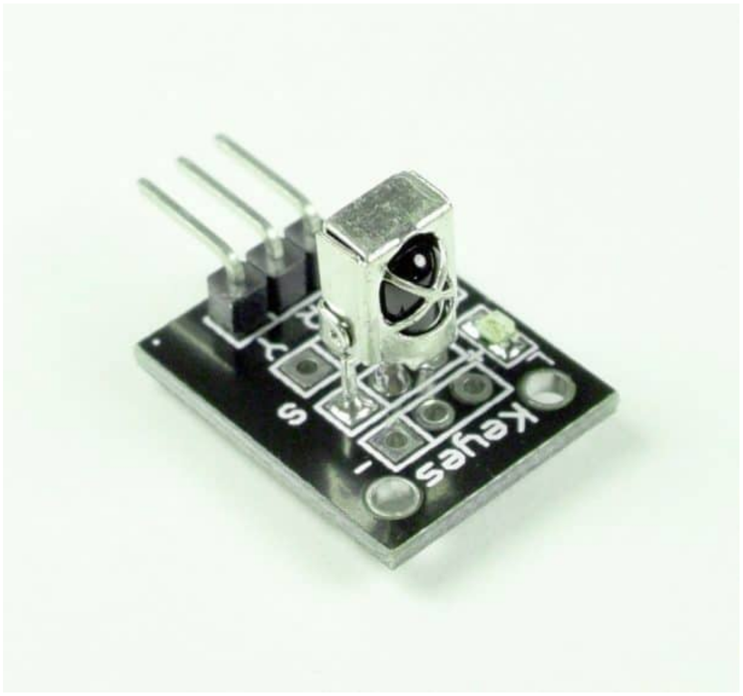
A typical infrared communication system requires an IR transmitter and an IR receiver. The transmitter looks just like a standard LED, except it produces light in the IR spectrum instead of the visible spectrum. If you have a look at the front of a TV remote, you'll see the IR transmitter LED:

The same type of LED is used in IR transmitter breakout boards for the Arduino. You can see it at the front of this Keyes IR transmitter:

IR receiver diodes typically look like this:



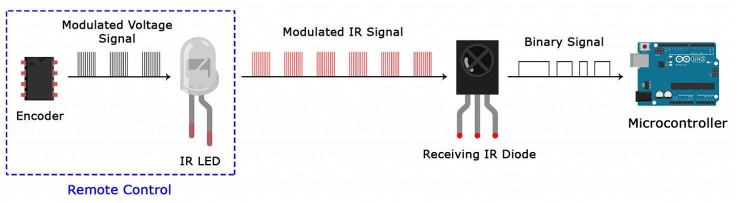
Some may come on a breakout board like this:



IR SIGNAL MODULATION

IR light is emitted by the sun, light bulbs, and anything else that produces heat. That means prevent this noise from interfering with the IR signal, a signal modulation technique is used.

In IR signal modulation, an encoder on the IR remote converts a binary signal into a modulated electrical signal. This electrical signal is sent to the transmitting LED. The transmitting LED converts the modulated electrical signal into a modulated IR light signal. The IR receiver then demodulates the IR light signal and converts it back to binary before passing on the information to a microcontroller:



The modulated IR signal is a series of IR light pulses switched on and off at a high frequency known as the carrier frequency. The carrier frequency used by most transmitters is 38 kHz, because it is rare in nature and thus can be distinguished from ambient noise. This way the IR receiver will know that the 38 kHz signal was sent from the transmitter and not picked up from the surrounding environment.

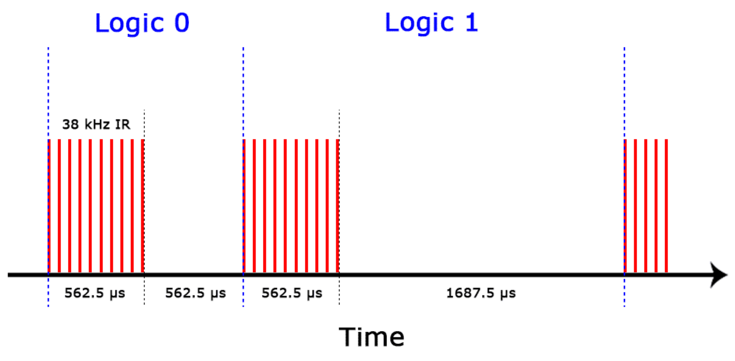
The receiver diode detects all frequencies of IR light, but it has a band-pass filter and only lets through IR at 38 kHz. It then amplifies the modulated signal with a pre-amplifier and converts it to a binary signal before sending it to a microcontroller.

IR TRANSMISSION PROTOCOLS

The pattern in which the modulated IR signal is protocol. There are many IR transmission protocols. Sony, Matsushita, NEC, and RC5 are some of the more common protocols.

The NEC protocol is also the most common type in Arduino projects, so I'll use it as an example to show you how the receiver converts the modulated IR signal to a binary one.

Logical '1' starts with a 562.5 µs long HIGH pulse of 38 kHz IR followed by a 1,687.5 µs long LOW pulse. Logical '0' is transmitted with a 562.5 µs long HIGH pulse followed by a 562.5 µs long LOW pulse:



This is how the NEC protocol encodes and decodes the binary data into a modulated signal. Other protocols differ only in the duration of the individual HIGH and LOW pulses.

IR CODES

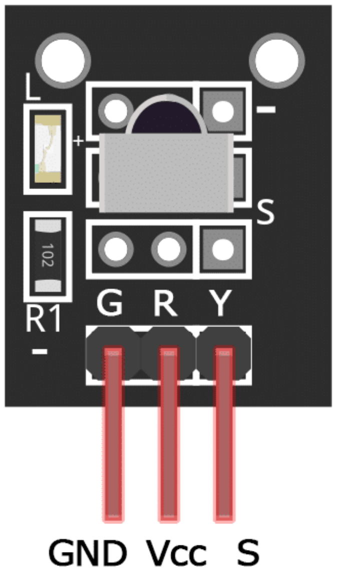
Each time you press a button on the remote control, a unique hexadecimal code is generated. This is the information that is modulated and sent over IR to the receiver. In order to decipher which key is pressed, the receiving microcontroller needs to know which code corresponds to each key on the remote.

Different remotes send different codes for the keypresses, so you'll need to determine the code generated for each key on your particular remote. If you can find the datasheet, the IR key codes should be listed. If not though, there is a simple Arduino sketch that will read most of the popular remote controls and print the hexadecimal codes to the serial monitor when you press a key. I'll show you how to set that up in a minute, but first we need to connect the receiver to the Arduino…

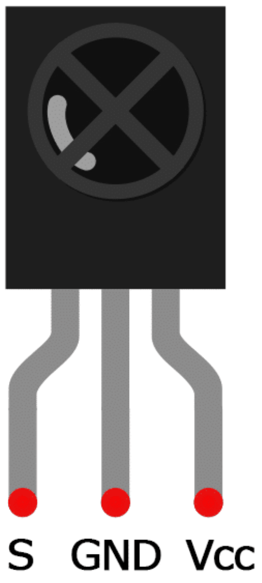
HOW TO CONNECT AN IR RECEIVER TO THE ARDUINO

There are several different types of IR receivers, some are stand-alone, and some are mounted on a breakout board. Check the datasheet for your particular IR receiver since the pins might be arranged differently than the HX1838 IR receiver and remote set I am using here. However, all IR receivers will have three pins: signal, ground, and Vcc.

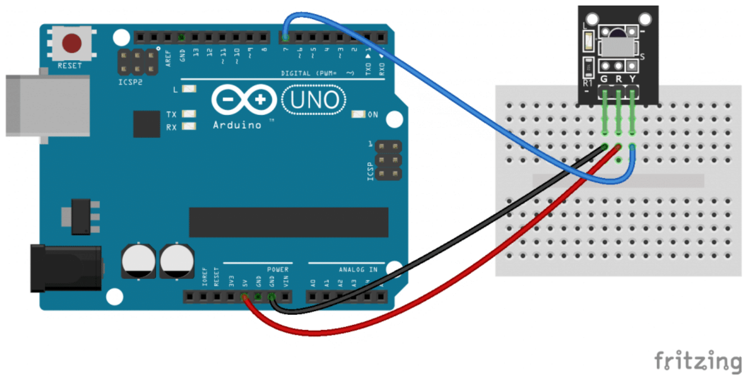
Lets get started with the hardware connections. The pin layout on most breakout boards looks like this:



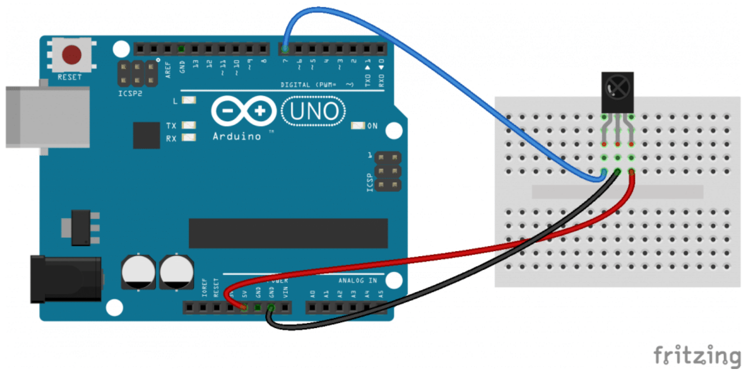
The pinout of most stand-alone diodes is like this:



To connect a breakout board mounted IR receiver, hook it up to the Arduino like this:



To connect a stand-alone receiver diode, wire it like this:



PROGRAMMING THE IR RECEIVER

Once you have the receiver connected, we can install the Arduino library and start programming. In the examples below, I'll show you how to find the codes sent by your remote, how to find the IR protocol used by your remote, how to print key presses to the serial monitor or an LCD, and finally, how to control the Arduino's output pins with a remote.

INSTALL THE IRREMOTE LIBRARY

We'll be using the IRremote library for all of the code examples below. You can download a ZIP file of the library from here.

To install the library from the ZIP file, open up

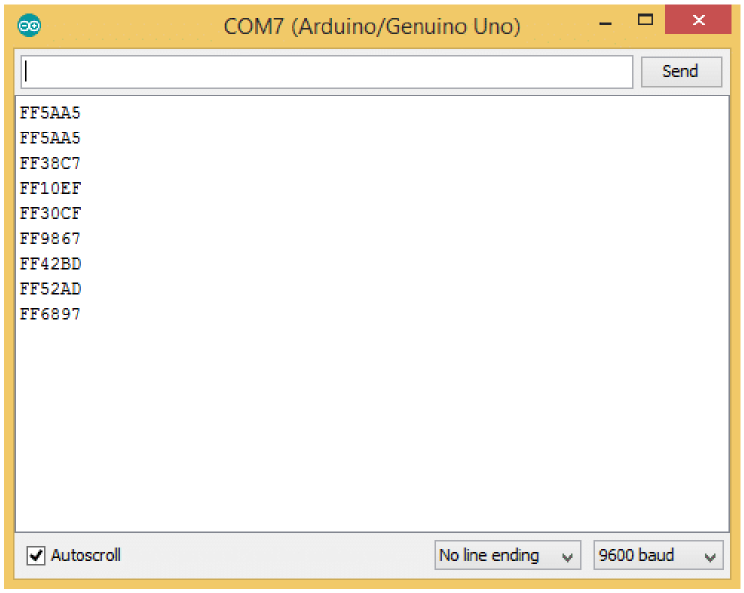
Library > Add .ZIP Library, then select the IRremote ZIP file that you downloaded from the link above.

FIND THE CODES FOR YOUR REMOTE

To find the key codes for your remote control, upload this code to your Arduino and open the serial monitor:

```
#include <IRremote.h>

const int RECV_PIN = 7;
IRrecv irrecv(RECV_PIN);
decode_results results;

void setup(){
  Serial.begin(9600);
  irrecv.enableIRIn();
  irrecv.blink13(true);
```

Now press each key on your remote and record the hexadecimal code printed for each key press.



```
FF5AA5
FF5AA5
FF38C7
FF10EF
FF30CF
FF9867
FF42BD
FF52AD
FF6897
```

Using the program above, I derived a table of keys and their corresponding codes from the remote that came with my HX1838 IR receiver and remote set. Note that you will receive a

Key	Code
CH-	0xFFA25D
CH	0xFF629D
CH+	0xFFE21D
<<	0xFF22DD
>>	0xFF02FD
>||	0xFFC23D
–	0xFFE01F
+	0xFFA857
EQ	0xFF906F
100+	0xFF9867
200+	0xFFB04F
0	0XFF6897
1	0xFF30CF
2	0xFF18E7
3	0xFF7A85
4	0xFF10EF
5	0xFF38C7
6	0xFF5AA5

7	0xFF42BD
8	0xFF4AB5
9	0xFF52AD

FIND THE PROTOCOL USED BY YOUR REMOTE

Knowing which protocol your remote uses can be useful if you want to work on some more advanced projects. Or you might just be curious. The program below will identify the protocol used by your remote. It even works on most remote controls around your house.

```
#include <IRremote.h>

const int RECV_PIN = 7;
IRrecv irrecv(RECV_PIN);
decode_results results;

void setup(){
  Serial.begin(9600);
  irrecv.enableIRIn();
  irrecv.blink13(true);
```

PRINT KEYS TO THE SERIAL MONITOR

I extended the code above to print the key value instead of the hexadecimal code:

```
#include <IRremote.h>

const int RECV_PIN = 7;
IRrecv irrecv(RECV_PIN);
decode_results results;
unsigned long key_value = 0;

void setup(){
  Serial.begin(9600);
  irrecv.enableIRIn();
```

If your remote sends different codes than the ones in the table above, just replace the hex code in each line where it says:

```
    case 0xFFA25D:
    Serial.println("CH-");
```

In these lines, when the hex code `0xFFA25D` is received, the Arduino prints "CH-".

HOW THE CODE WORKS

For any IR communication using the IRremote library, first we need to create an object called `irrecv` and specify the pin number where the IR receiver is connected (line 3). This object will take care of the protocol and processing of the information from the receiver.

The next step is to create an object called `results` , from the `decode_results` class, which will be used by the `irrecv` object to share the decoded information with our application (line 5).

In the `void setup()` block, first we configure the serial monitor baud rate. Next we start the IR receiver by calling the `IRrecv` member function `enableIRIn()` (line 10).

The `irrecv.blink13(true)` function on line 11 will blink the Arduino's on board LED every time the receiver gets a signal from the remote control, which is useful for debugging.

In the `void loop()` block, the function `irrecv.decode` will return true if a code is received and the program will execute the code in the if statement. The received code is stored in `results.value`. Then I used a switch to handle each IR code and print the

Before the switch block starts there is a conditional block:

```
    if (results.value == 0XFFFFFFFF)
    results.value = key_value;
```

If we receive 0XFFFFFFFF from the remote, it means a repetition of the previous key. So in order to handle the repeat key pattern, I am storing the hex code in a global variable `key_value` every time a code is received:

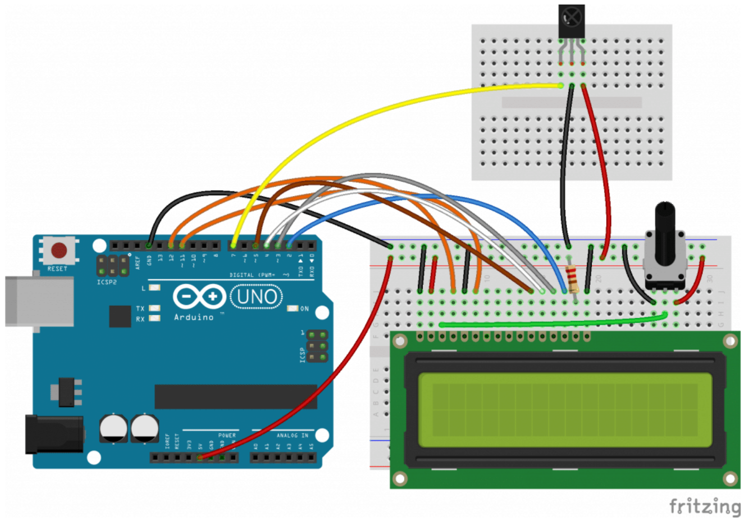
```
    key_value = results.value;
```

When you receive a repeat pattern, then the previously stored value is used as the current key press.

At the end of the `void loop()` section, we call `irrecv.resume()` to reset the receiver and prepare it to receive the next code.

PRINT KEYS TO AN LCD

Instead of printing the key values to the serial monitor, you can also display the information on an LCD. Check out our article on setting up and programming an LCD on the Arduino for more information on programming the LCD, but the basic setup looks like this:



The resistor sets the LCD's backlight brightness. It can be anything from 200 ohms to about 2K ohms. The potentiometer sets the character contrast. I normally use a 10K ohm potentiometer for this one.

Once everything is connected, upload this code to the Arduino:

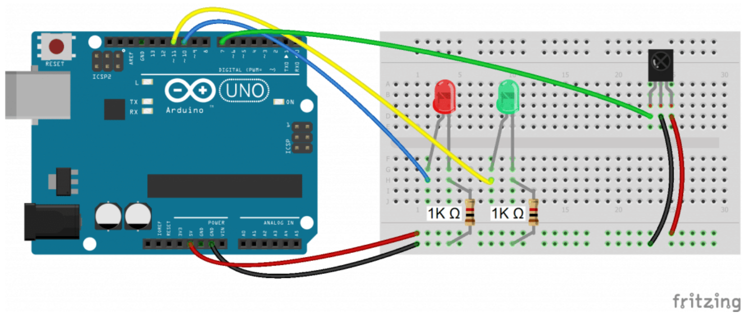
```
#include <IRremote.h>
#include <LiquidCrystal.h>

const int RECV_PIN = 7;
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
IRrecv irrecv(RECV_PIN);
decode_results results;
unsigned long key_value = 0;

void setup(){
```

Again, if the hex codes don't match the codes output by your remote, just replace them for each character where it says `case 0xXXXXXXXX;`.

USING THE IR REMOTE TO CONTROL THINGS

Now I'll show you a simple demonstration of how you can use the IR remote to control the Arduino's output pins. In this example, we will light up an LED when a particular button is pressed. You can easily modify the code to do things like control servo motors, or activate relays with any button press from the remote.

The example circuit has the IR receiver connected to the Arduino, with a red LED connected to pin 10 and a green LED connected to pin 11:



The code below will write digital pin 10 HIGH for 2 seconds when the “5” button is pressed, and write digital pin 11 HIGH for 2 seconds when the”2″ button is pressed:

```
#include <IRremote.h>

const int RECV_PIN = 7;
IRrecv irrecv(RECV_PIN);
decode_results results;
const int redPin = 10;
const int greenPin = 11;


void setup(){
```

So far we have covered the properties of infrared radiation and how communication happens between the transmitter and receiver. We saw how to identify the IR key codes for a given remote control. We learned how to display key presses on serial monitor and on an LCD screen. Finally I showed you how to control the Arduino’s output with the remote. Have fun playing with this and be sure to let us know in the comments if you have any questions or trouble setting this up!

Krishna Pattabiraman is a frequent guest writer on Circuit Basics and the founder of www.codelectron.com.

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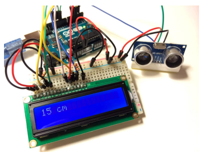
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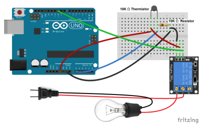
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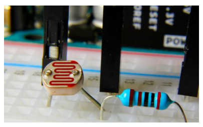
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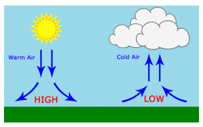

How to Set Up the BMP180 Barometric Pressure Sensor on an Arduino

24 COMMENTS

StEw Lindenberger on November 2, 2017 at 4:41 pm

Thank you.

A well presented, informative and useful overview including specific examples for implementation. Bravo.

REPLY

Jeremy Borg on November 3, 2017 at 10:18 am

A very well written and informative article. One thing I would have liked to learn more about is how to choose the IR emitter and receiver. My local store stocks several options of each, does it matter which one I choose? https://www.fabian.com.mt/en/products/webshop/bycategory/843/name/asc/18/1/infrared–uv-emitters-and-receivers.htm

REPLY

Stan on November 3, 2017 at 3:26 pm

Well written, clear and concise. Keep it up.

REPLY

Shekhar on November 17, 2017 at 11:03 am

Are the codes complete?

REPLY

Hello hope that you all are fine. my Ir reciever giving me continous values on serial moniter although i am sending no signals to it. kindly reply. Thanks

REPLY

anonymous on March 22, 2019 at 5:37 pm

i'm 2 years too late, but you don't need to type anything in the monitor

REPLY

peter obasa on January 6, 2018 at 1:41 pm

Hi, please i try loading the code on uno and nano board this is the error message (

Build options changed, rebuilding all
C:\Program Files (x86)\Arduino\libraries\RobotIRremote\src\IRremoteTools.cpp:5:16: error: 'TKD2' was not declared in this scope

int RECV_PIN = TKD2; // the pin the IR receiver is connected to

^

exit status 1
Error compiling for board Arduino/Genuino Uno.
)

please what should i do , thanks in advance

REPLY

Hi, late but hopefully still helpful, if not for you maybe for somebody else.
This error-message occurs when you're using the "Robot IR Remote" library instead of the "IRremote" library, which you would first have to import, either by using the buildt-in feature of the Arduino-IDE, or by downloading a ZIP-archive.

REPLY

Sunil on August 31, 2018 at 8:28 pm

How to remove receiving NEC repeat code. From my remote control it always display 0xFFFFFFFF but when i presses key fast at once it display correct value like 18E7E817 so how to turn off receiving repeat code. Please help.

REPLY

Luca Segalla on September 28, 2018 at 6:49 pm

If you have problems like "error: 'TKD2' was not declared in this scope – int RECV_PIN = TKD2; // the pin the IR receiver is connected to" just remove the "RobotIRremote" default library and install the "Arduino-IRremote-master". Then rename the folder "Arduino-IRremote-master" in "IRremote". That's all.

REPLY

medo on October 20, 2018 at 7:08 pm

hi,
i connected atmega 328 ic with 4 relayes. really, i

adapter.

The other cycle contained 4 relayes, each one have 1 daiods and 574 transistor. this cycle was supported using 5v (1 amp) adapter.

those cycles were conected from (a)- cathode (b)- the ic's output pins to the transistors.

the target was to open/close each relay by lg-tv remote control. the cycle work very will through 1 hour from starting point, but after that it hang and not receive the signals.

um looking forward to hearing from you, why this problem is happened.

REPLY

trinity fogarty on November 11, 2018 at 10:15 am

hi there,

for some reason the program never finishes uploading onto my uno. The program verifies properly and I see some on the memory usage figures but it just never finishes. Any ideas?

REPLY

ambitsemi on November 27, 2018 at 11:21 am

this article is very informative..keep sharing.....

REPLY

Colin on December 17, 2018 at 9:36 pm

I'm stuck at the LCD part. I am relatively confident I have connected everything properly, as I have checked and rechecked. However nothing displays on the screen. Is there a way to trouble shoot this?
Thank you,
Colin

REPLY

Colin on December 17, 2018 at 9:38 pm

Its working now! Sorry, I turned on serial monitor in arduino and it started to work. Coincidence?
Thanks:)

REPLY

Andreas on December 22, 2018 at 9:09 pm

Thx helped me out a lot with my project. Clearly structured and nice to read. Worked like a charm

REPLY

Serge Nadeau on December 27, 2018 at 1:05 am

Hi,
I have been looking for an understandable explanation how to use a IR receiver with Arduino for a while.
Your explanation is the first that is simple and understandable for a beginner.
Thanks to put such good quality information on this site.

REPLY

Very well written tutorial. Thanks!
Is there a way to speed up the response when the remote button is pushed? There seems to be about a 3-4 second delay between button push and LED response in most cases.

REPLY

Jim DiGriz on January 16, 2019 at 3:52 am

Wow, this was actually exciting and fun.
Each piece of code worked. I could read the codes.
It told me the manufacturer.
Now I'm ready to buy a used/discarded remote from a thrift store, map its keys, and use it to drive relays.
Thanks very much for short clear instructions.

REPLY

ioan on February 2, 2019 at 12:55 pm

My 3 IR receivers are always blinking even before I add the code, and aren't receiving any data sent from a functional RGB remote controller.
Please, can someone help me?

REPLY

GonCALO CALVINHO on February 16, 2019 at 8:06 pm

Very informative and helpful, thanks!

One question though, why can't I identify the protocol of my garage door remote?
I can do it with the tv remote just fine but the garage door opener I can't. Doesn't it use IR as

REPLY

ジロラッタ バッグ on February 24, 2019 at 6:38 am

I have read so many articles or reviews about the blogger
lovers except this post is in fact a nice paragraph, keep it
up. http://www.cardtricksdesigns.com/lva.php

REPLY

saket on February 25, 2019 at 5:40 pm

when i try to get the codes for my remote after clicking the serial moniter it automatically starts giving the values why??

REPLY

click here on March 22, 2019 at 7:11 am

I just like the helpful info you provide to your articles.
I will bookmark your blog and test once more right here regularly. I am somewhat certain I will be told a lot of new stuff proper right here!

Good luck for the following!

REPLY

LEAVE A REPLY

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