Note polarity! Also use a series resistor. LED’s can take 20mA. In most cases 330R is good enough.

Resistors do not have polarization. Colored rings are used to denote the value. Ohm’s law applies: \( V = I \times R \)

A switch can be connected using a 10k pull-up resistor. (or pull-down)
You might have to straighten the legs to fit the breadboard

10k Potentiometer
Can be connected to analog input, or can be used to reduce an analog signal.
Electret Microphone

This microphone needs a voltage using a [1..2.2k] pull-up resistor, decoupling capacitor and an amplifier circuit.

Note polarity!
The negative side is connected with the casing (see backside)

220x amplifier + offset voltage. The 100nF capacitor works as high-pass filter

TL272 OpAmp (LM358 is compatible)

OpAmp stands for ‘operational amplifier’.

The polarization is given using a dot on the first pin, the small notch also denotes the side with pin 1. The chip contains two OpAmps and requires a supply voltage of at least 5V

Electret Microphone

Note polarity!
The negative side is connected with the casing (see backside)

This microphone needs a voltage using a [1..2.2k] pull-up resistor, decoupling capacitor and an amplifier circuit.

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The polarization is given using a dot on the first pin, the small notch also denotes the side with pin 1. The chip contains two OpAmps and requires a supply voltage of at least 5V

Ceramic capacitor 100 nF

This is a small capacitor, used in analog signal schematics. It has no polarization. Mostly used in RC-networks as filter.

Touch sensor

Using the large 10M resistor and two Arduino pins you can make a capacitive touch sensor. Check http://www.arduino.cc/playground/Main/CapSense
**RGB LED**

An RGB LED contains three separate LED’s which share a common cathode(-).

**IR LED**

Connection is the same as with normal LED’s. This LED can be used to mimic your IR remote signals using Arduino library [IRremote.h](https://github.com/ken Shirriff). Note polarity! Light of this LED is not visible with the eye. Most digital camera’s can detect IR. Also use a series resistor.

**TSOP4838 IR receiver**

This sensor can detect and decode IR signals sent by a remote control. Use Arduino library [IRremote.h](https://github.com/ken Shirriff) by Ken Shirriff to decode most of the available remotes. Connect sensor OUT to an Arduino input.

**Electrolytic capacitor 10 uF**

This is the larger capacitor, also used in analog signal schematics and power supply stabilization. Note the polarization!

**LDR**

An LDR has no polarity. It can be connected using a pull-up resistor of 10k to an Arduino input.

**NTC resistor**

The NTC resistor needs a pull-up resistor of 10k. It can detect temperatures between -55 and +125 degrees C. The resistor has a value of 100k at room temperature. The NTC resistor has no polarization, it is a resistive sensor.
Piezo buzzer

When amplification of the beeps is necessary, the transistor circuit described here can be used. Also making a physical (horn) shape around the buzzer can increase the volume...

Piezo buzzer can be connected directly to Arduino's output pins. Use the tone library (built in) to make bleeps. Connect to (¬) and to an output pin.

Note polarity and pinning. Use this transistor to amplify signals or switch loads up to 1A at 35V (max). Use a reverse diode to prevent back EMF.

1N4148 diode

Note polarity. Diodes conduct current only in one way (when the stripe is connected to a (¬), it will conduct).

CNY 70 reflection sensor

This sensor contains one phototransistor and one IR LED. Together they act as reflection sensor. Use a series resistor with the LED and a pull-up resistor for the transistor. The wires should be bent.

Interfacing the CNY70 reflective sensor
Breadboard

The horizontal rows are called ‘rail’ and are mostly used for connecting power and ground. Note that on larger breadboards there can be one or more gaps in these rails.

The vertical columns are used to connect the components. They are grouped in rows of 5 connection points.

Breadboards do not have infinite life, connections can become flaky over time.

Phototransistor

Note polarity. The same markings used with an LED apply. A phototransistor or photodiode conducts current depending on received light intensity. Use a pull-up resistor.

Phototransistor

Atmega168 Pin Mapping

NE555 timer

Versatile timing chip. Can be used to make oscillators, PWM generators, delay timers etc. In this circuit:

Frequency = 1.44/ (R1 + 2R2) C [Hz]
Dutycycle = R2 / (R1 + 2R2) [%]

Checkout:
http://en.wikipedia.org/wiki/555_timer_IC