ARDUINO

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JOHDANTO

Johdanto

Arduino on työkalu sulautettujen järjestelmien suunnitteluun ja rakenteluun. Se koostuu avoimiin suunnitelmiin perustuvasta mikrokontrollerista, johon liittyy sisään- ja ulostulon tuki ja standardoitu ohjelmointikieli.

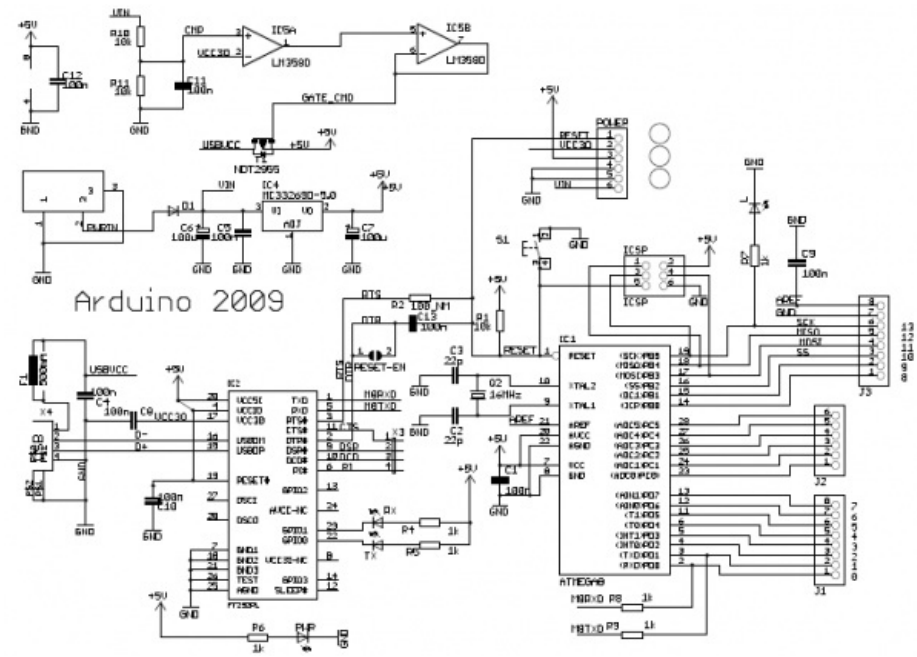
Arduinoa ohjelmoidaan Wiring-ohjelmointikielellä, joka on käytännössä hieman muunneltua C++-ohjelmointikieltä.

Avoimen lähdekoodin mikrokontrolleri

Kuinka laite voi perustua avoimeen lähdekoodiin?

Arduinon piirrustukset ovat saatavilla internetistä, voit käyttää niitä samaan tapaan kuin avoimen lähdekoodin ohjelmia. Voit tutkia niitä, muuttaa niitä tai rakentaa Arduinon niiden avulla.

Voit ladata eri Arduino-mallien piirrokset Arduinon sivuilta ja muokata niitä tahtoessasi.



Mahdollisesti helpompaa on kuitenkin tilata Arduino verkkokaupasta. Tällainen on Suomessa esimerkiksi Paeae.com.

OHJELMOINTIYMPÄRISTÖ

Asennus Ubuntuun

Somebody Should Set The Title For This Chapter!

Arduinon kehitysympäristö

Arduinon kehitysympäristö koostuu tekstieditorista, jolla kirjoitetaan koodia, viestialueesta, tekstipäätteestä, yleisimmät toiminnot sijaitsevasta työkalupalkista, ja sarjasta valikkoja. Se ottaa yhteyden Arduino-mikrokontrolleriin ladatakseen ohjelmia ja viestiäkseen niiden kanssa.

Arduinolla kirjoitettuja ohjelmia kutsutaan luonnoksiksi ("sketch"). Nämä luonnokset kirjoitetaan tekstiedistorissa. Siinä on ominaisuudet tekstin leikkaamiseen ja liittämiseen, sekä tekstin etsimiseen/korvaamiseen. Konsoli näyttää tekstiulostulon Arduinon ympäristöstä, siihen sisältyy täyelliset virheviestit ja muuta tietoa. Työkalupalkin nappulat antavat sinun tarkistaa ja ladata ohjelmia, luoda, avata ja tallentaa luonnoksia, sekä avata sarjamonitorin:


Varmista/Käännä
Tarkastaa koodisi virheet.


Pysäytä
Pysäyttää sarjamonitorin, tai ottaa muut napit pois käytöstä.


Uusi
Luo uuden luonnoksen.


Avaa
Näyttää valikon kaikista luonnoskirjassasi olevista luonnoksista. Sen napsauttaminen avaa sen nykyisessä ikkunassa.


Tallenna
Tallentaa luonnoksesi.


Lataa Arduinon sisään/ulostuloon
Kääntää koodisi ja lataa sen Arduinon sisään/ulostuloon.


Sarjamonitori
Avaa sarjamonitorin.

Lisäkomennot löytyvät viidestä valikosta: File (tiedosto), Edit (muokkaa), Sketch (luonnos), Tools (työkalut) ja Help (apua). Nämä valikot ovat tilannesidonnaisia, joten ainostaan juuri nyt tehtävään työhön liittyvät vaihtoehdot ovat tarjolla.

Edit

- *Copy for Discourse*
  Copies the code of your sketch to the clipboard in a forum suitable for posting to the forum, complete with syntax coloring.
- *Copy as HTML*
  Copies the code of your sketch to the clipboard as HTML, suitable for embedding in web pages.

Sketch

- *Verify/Compile*
  Checks your sketch for errors.
- *Import Library*
  Adds a library to your sketch by inserting #include statements at the code of your code. For more details, see libraries below.
- *Show Sketch Folder*
  Opens the sketch folder on the desktop.
- *Add File...*
  Adds a source file to the sketch (it will be copied from its current location). The new file appears in a new tab in the sketch window. Files can be removed from the sketch using the tab menu.

Tools

- *Auto Format*
  This formats your code nicely: i.e. indents it so that opening and closing curly braces line up, and that the statements instead curly braces are indented more.
- *Board*
  Select the board that you're using. See below for descriptions of the various boards.
- *Serial Port*
  This menu contains all the serial devices (real or virtual) on your machine. It should automatically refresh every time you open the top-level tools menu.
- *Burn Bootloader*
  The items in this menu allow you to burn a bootloader onto the microcontroller on an Arduino board. This is not required for normal use of an Arduino board but is useful if you purchase a new ATmega (which normally come without a bootloader). Ensure that you've selected the correct board from the **Boards** menu before burning the bootloader. When using an AVR ISP, you'll need to select the item corresponding to your programmer from the **Serial Port** menu.

Sketchbook

The Arduino environment includes the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the **File > Sketchbook** menu or from the **Open** button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the **Preferences** dialog.

Tabs, Multiple Files, and Compilation

Allows you to manage sketches with more than one file (each of which appears in its own tab). These can be normal Arduino code files (no extension), C files (.c extension), C++ files (.cpp), or header files (.h).

Uploading

Before uploading your sketch, you need to select the correct items from the **Tools > Board** and **Tools > Serial Port** menus. The boards are described below. On the Mac, the serial port is probably something like **/dev/tty.usbserial-1B1** (for a USB board), or **/dev/tty.USA19QW1b1P1.1** (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably **COM1** or **COM2** (for a serial board) or **COM4**, **COM5**, **COM7**, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be **/dev/ttyUSB0**, **/dev/ttyUSB1** or similar.

Once you've selected the correct serial port and board, press the upload button in the toolbar or select the **Upload to I/O Board** item from the **File** menu. Current Arduino boards will reset automatically and begin the upload. With older boards that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino environment will display a message when the upload is complete, or show an error.

When you upload a sketch, you're using the Arduino bootloader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The bootloader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The bootloader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

Libraries

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the **Sketch > Import Library** menu. This will insert one or more **#include** statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its **#include** statements from the top of your code.

There is a list of libraries in the reference. Some libraries are included with the Arduino software. Others can be downloaded from a variety of sources. To install these third-party libraries, create a directory called **libraries** within your sketchbook directory. Then unzip the library there. For example, to install the DateTime library, its files should be in the **/libraries/DateTime** sub-folder of your sketchbook folder.

Third-Party Hardware

Support for third-party hardware can be added to the **hardware** directory of your sketchbook directory. Platforms installed there may include board definitions (which appear in the board menu), core libraries, bootloaders, and programmer definitions. To install, create the **hardware** directory, then unzip the third-party platform into its own sub-directory. (Don't use "arduino" as the sub-directory name or you'll override the built-in Arduino platform.) To uninstall, simply delete its directory.

For details on creating packages for third-party hardware, see the platforms page on the Google Code developers site.

Serial Monitor

Displays serial data being sent from the Arduino board (USB or serial board). To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down that matches the rate passed to **Serial.begin** in your sketch. Note that on Mac or Linux, the Arduino board will reset (rerun your sketch from the beginning) when you connect with the serial monitor.

You can also talk to the board from Processing, Flash, MaxMSP, etc (see the interfacing page for details).

Preferences

Some preferences can be set in the preferences dialog (found under the **Arduino** menu on the Mac, or **File** on Windows and Linux). The rest can be found in the preferences file, whose location is shown in the preference dialog.

Boards

The board selection has two effects: the parameters (e.g. CPU speed and baud rate) used when compiling and uploading sketches; and the file and fuse settings used by the burn bootloader command. Some of the board definitions differ only in the latter, so even if you've been uploading successfully with a particular selection you'll want to check it before burning the bootloader.

- *Arduino Duemilanove or Nano w/ ATmega328*
  An ATmega328 running at 16 MHz with auto-reset. Also used for the 16 MHz (5V) versions of the Arduino Pro or Pro Mini with an ATmega328.
- *Arduino Diecimila, Duemilanove, or Nano w/ ATmega168*
  An ATmega168 running at 16 MHz with auto-reset. Compilation and upload is equivalent to Arduino NG or older w/ ATmega168, but the bootloader burned has a faster timeout (and blinks the pin 13 LED only once on reset). Also used for the 16 MHz (5V) versions of the Arduino Pro and Pro Mini with an ATmega168.
- *Arduino Mega*
  An ATmega1280 running at 16 MHz with auto-reset.
- *Arduino Mini*
  Equivalent to Arduino NG or older w/ ATmega168 (i.e. an ATmega168 running at 16 MHz without auto-reset).
- *Arduino BT*
  ATmega168 running at 16 MHz. The bootloader burned includes codes to initialize the on-board bluetooth module.
- *LilyPad Arduino w/ ATmega328*
  An ATmega328 running at 8 MHz (3.3V) with auto-reset. Equivalent to Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega328.

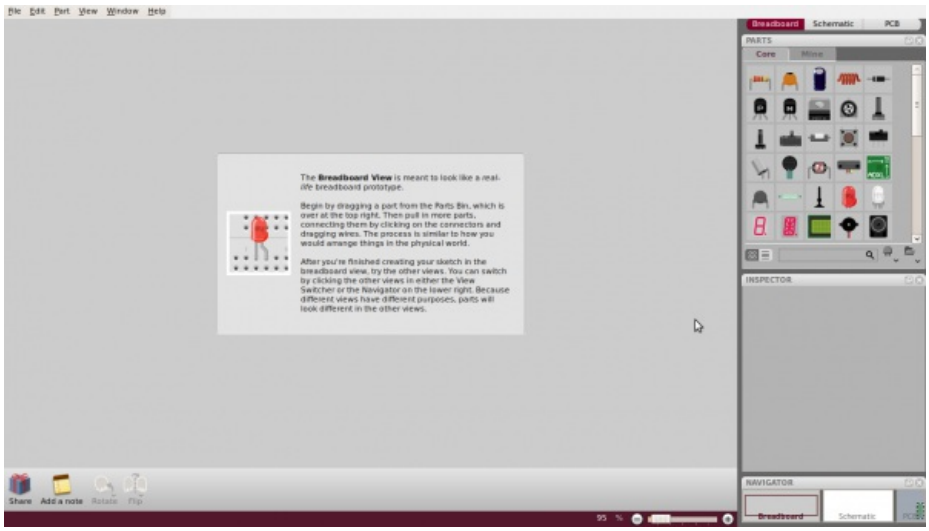
- *LilyPad Arduino w/ ATmega168*
  An ATmega168 running at 8 MHz. Compilation and upload is equivalent to the Arduino Pro or Pro Mini (8 MHz) w/ ATmega168. The bootloader burned, however, has a slower timeout (and blinks the pin 13 LED three times on reset) because the original versions of the LilyPad didn't support auto-reset. They also didn't include an external clock, so the burn bootloader command configures the fuses of ATmega168 for an internal 8 MHz clock.

  If you have a recent version of the LilyPad, (w/ a 6-pin programming header), you'll want to select Arduino Pro or Pro Mini (8 MHz) w/ ATmega168 before burning the bootloader.
- *Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega328*
  An ATmega328 running at 8 MHz (3.3V) with auto-reset. Equivalent to LilyPad Arduino w/ ATmega328.
- *Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega168*
  An ATmega168 running at 8 MHz (3.3V) with auto-reset.
- *Arduino NG or older w/ ATmega168*
  An ATmega168 running at 16 MHz *without* auto-reset. Compilation and upload is equivalent to Arduino Diecimila or Duemilanove w/ ATmega168, but the bootloader burned has a slower timeout (and blinks the pin 13 LED three times on reset).
- *Arduino NG or older w/ ATmega8*
  An ATmega8 running at 16 MHz *without* auto-reset.

FRITZING

Fritzing

Fritzing luotiin helpottamaan Arduino-projektien dokumentaatiota.



Alueet:

- Parts

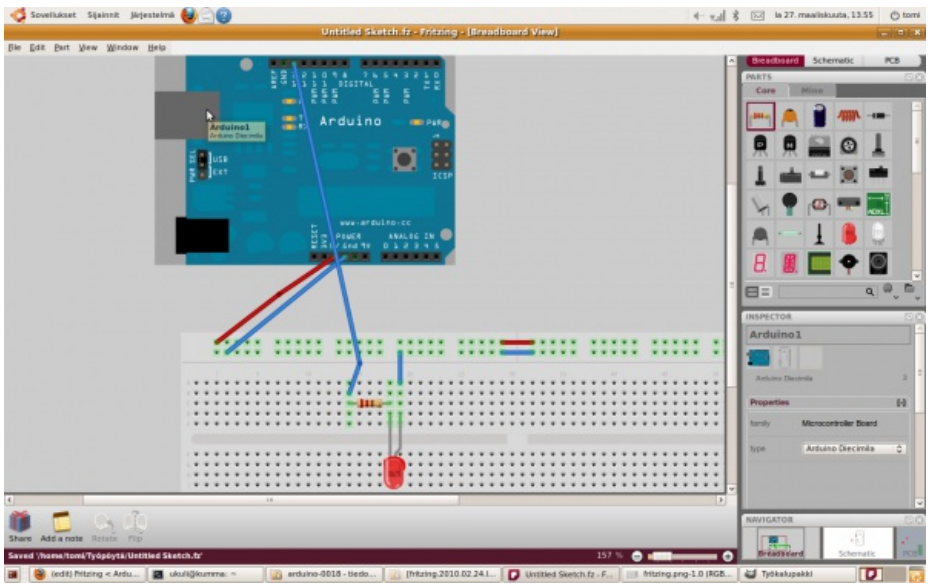
- Project Area

- Inspector

- Navigator

1) Lediesimerkki (BLINK)

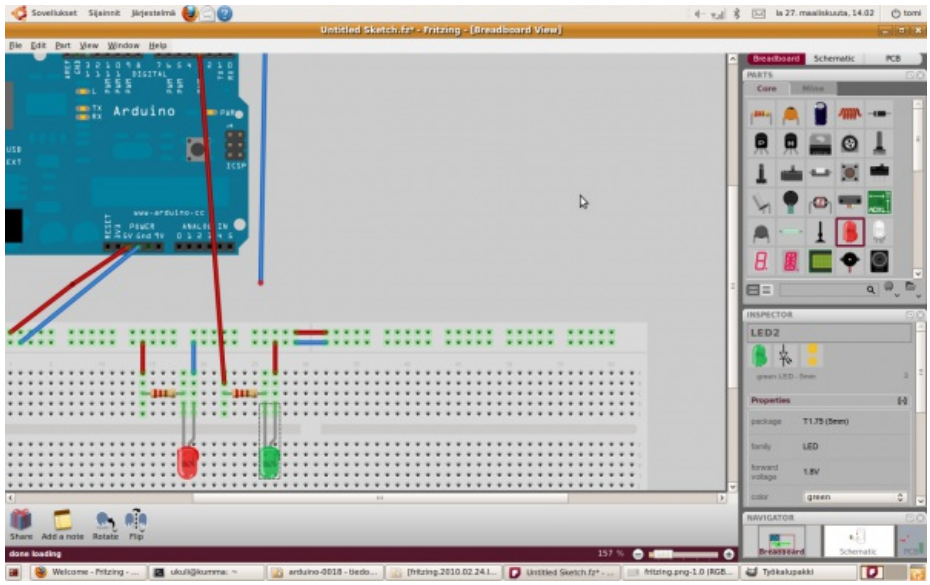
2) Pidä hiiri pohjassa - vedä breadboardilla - voit vetää johtoa ja näyttää toisiinsa kytketyt kolot.



ANALOG - SELITÄ ANALOGINEN

DIGITAL - SELITÄ DIGITAALINEN

Käytä koodilla Fading:



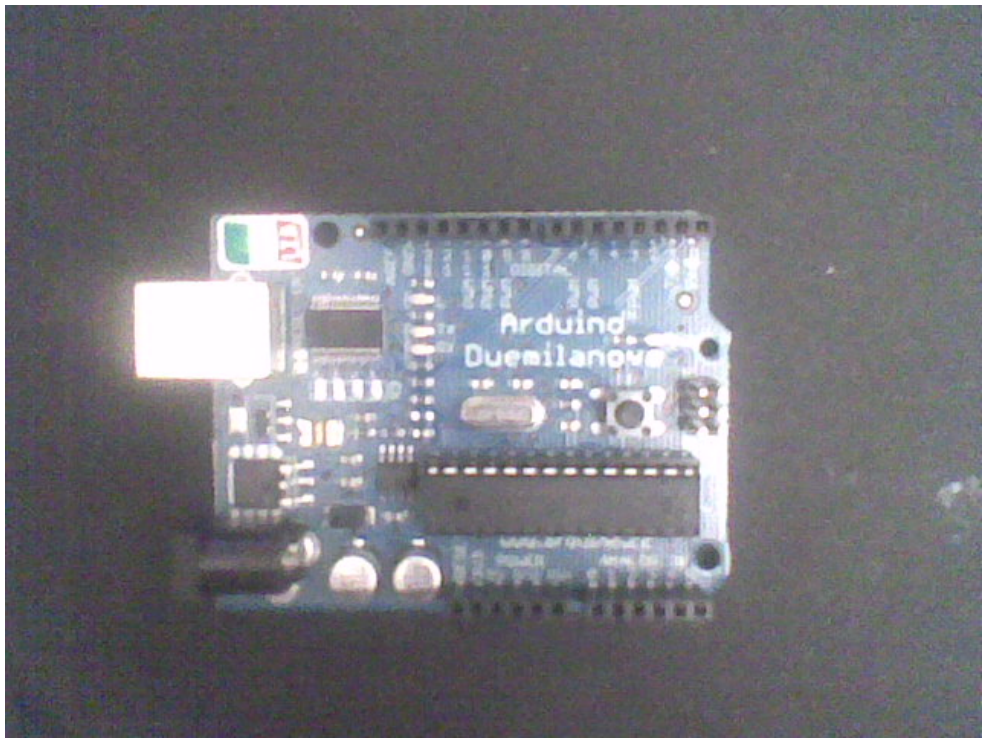
ARDUINO

Arduino

Tämä yksinkertainen esimerkki Arduinon ohjelmoinnista käytöstä yhden komponentin kanssa on otettu Arduinon kotisivulta.

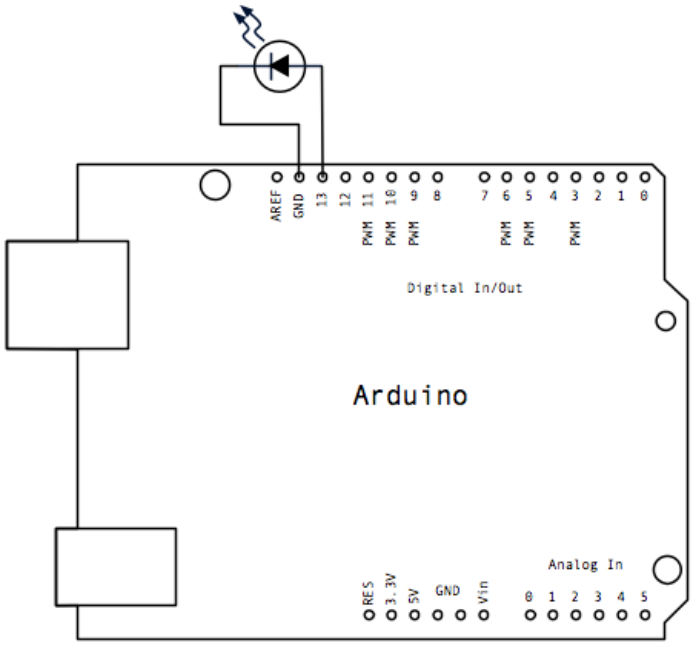
Kuvassa näemme Arduino Duomilanove -mikrokontrollerin.

(Parempi kuva!)

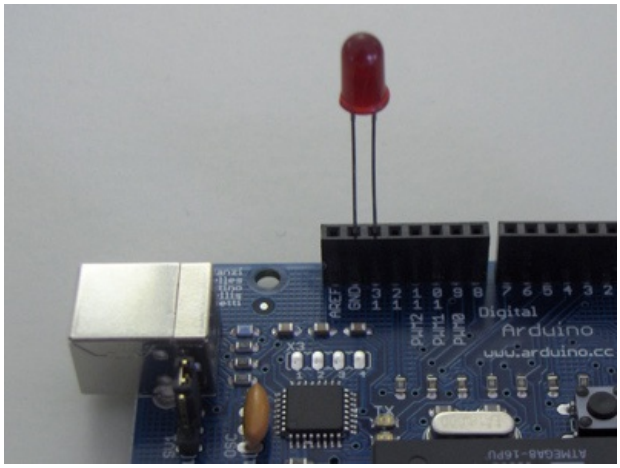


Ohjelmoidaksesi Arduinoa joudut kytkemään sen tietokoneeseesi USB-kaapelilla. USB-kaapeli toimii ohjelmointikaapelina, mutta samalla myös sähköjohtona, joten Arduino saa virran USB-johdosta.

Tässä esimerkissä tarvitset yhden ledin, jonka liität Arduinoon kaavakuvan osoittamalla tavalla.



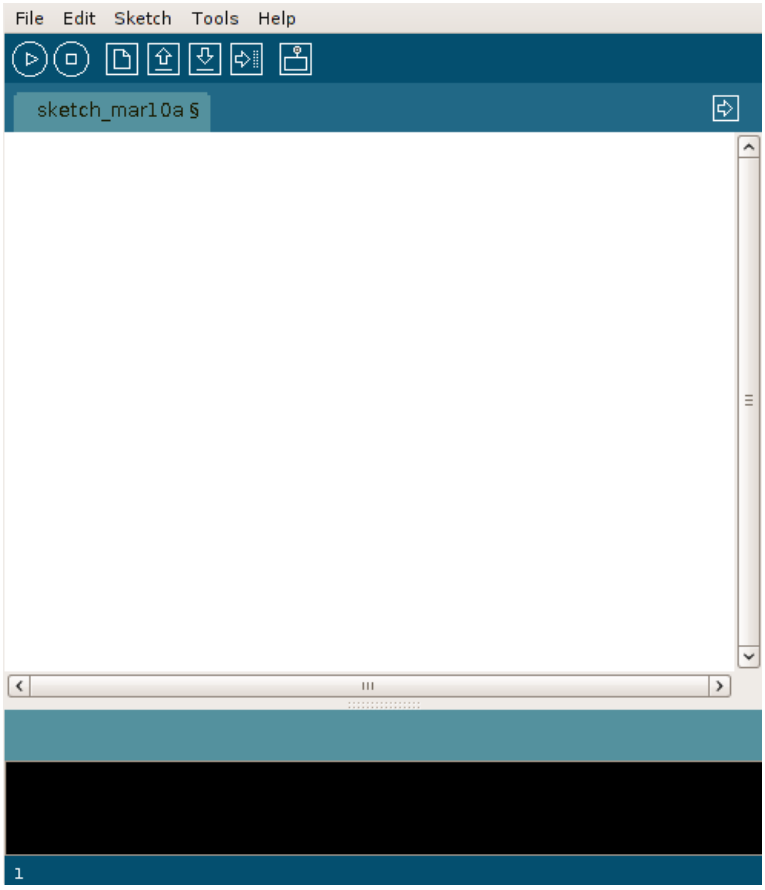
Alla ledi liitettynä Arduinoon:



Ohjelmoidaksesi Arduinoa joudut kytkemään sen tietokoneeseesi USB-kaapelilla. USB-kaapeli toimii ohjelmointikaapelina, mutta samalla myös sähköjohtona, joten Arduino saa virran USB-johdosta.

(Parempi kuva!)

Nyt voit käynnistää Arduino IDE:n tietokoneessasi. Tämä ohjelma toimii Arduinon ohjelmointiympäristönä.



Seuraavaksi voit ohjelmoida Arduinon tällä yksinkertaisella koodilla.

```
/*
  Blink

 Turns on an LED on for one second, then off for one second, repeatedly.

 The circuit:
 * LED connected from digital pin 13 to ground.

 * Note: On most Arduino boards, there is already an LED on the board
 connected to pin 13, so you don't need any extra components for this example.


 Created 1 June 2005
 By David Cuartielles

 http://arduino.cc/en/Tutorial/Blink

 based on an orginal by H. Barragan for the Wiring i/o board

This example code is in the public domain.


 */

int ledPin =  13;    // LED connected to digital pin 13

// The setup() method runs once, when the sketch starts
```

```
void setup()   {
  // initialize the digital pin as an output:
  pinMode(ledPin, OUTPUT);
}

// the loop() method runs over and over again,
// as long as the Arduino has power

void loop()
{
  digitalWrite(ledPin, HIGH);   // set the LED on
  delay(1000);                  // wait for a second
  digitalWrite(ledPin, LOW);    // set the LED off
  delay(1000);                  // wait for a second
}
```

OHJELMOINTIKIELI

Ohjelmointikieli

Rakenne

setup()

Asetusfunktio setup() kutsutaan ohjelmaluonnoksen alkaessa. Käytä sitä alustaaksesi muuttujat, pinnien tilat, kirjastojen käytön aloituksen, jne. Käynnistysfunktio suoritetaaan vain kerran, jokaisen käynnistyksen tai alkutilaan asettamisen yhteydessä.

Esimerkki

```
int buttonPin = 3;

void setup()
{
  Serial.begin(9600);
  pinMode(buttonPin, INPUT);
}

void loop()
{
  // ...
}
```

loop()

Asetusfunktio setup() alustaa ja asettaa alkuarvot, jonka jälkeen loop()-silmukkafunktio aloittaa silmukan, jolloin ohjelmasi voi muuttua ja reagoida tilanteen kehitykseen. Käytä sitä hallitaksesi aktiivisesti Arduino-mikrokontrolleria.

Esimerkki

```
int buttonPin = 3;

// setup alustaa sarja- ja nappipinnin
void setup()
{
  beginSerial(9600);
  pinMode(buttonPin, INPUT);
}

// silmukka tarkastaa nappipinnin joka kerralla, ja lähettää sarjalliseen, mikäli
// sitä painetaan
void loop()
{
  if (digitalRead(buttonPin) == HIGH)
    serialWrite('H');
  else
    serialWrite('L');

  delay(1000);
}
```

if (ehdollinen operaattori) ja == < > (vertailuoperaattorit)

Ehdollinen operaattori if, jota käytetään vertailuoperaattorin yhteydessä, testaa onko tietty ehto saavutettu, kuten ylittääkö sisääntulo tietyn arvon. Tällaisen testin muoto on:

```
if (jokuMuuttuja > 50)
{
  // Tee jotain tässä.
}
```

Ohjelma testaa onko jokuMuuttuja suurempi kuin 50. Jos se on, ohjelma tekee tietyn toiminnon. Toisella tavalla ilmaistuna, mikäli lausunto sulkujen sisällä on totta, aaltosulkujen sisällä olevat lausunnot ajetaan. Jos ei, ohjelma hyppää koodin yli.

Aaltosulut voidaan jättää pois if-lausunnon jälkeen. Jos näin tehdään, seuraavalla rivillä (puolipisteen määrittämästä) tulee ainoa ehdollinen lausunto.

```
if (x > 120) digitalWrite(LEDpin, HIGH);

if (x > 120)
digitalWrite(LEDpin, HIGH);

if (x > 120){ digitalWrite(LEDpin, HIGH); }

if (x > 120){
  digitalWrite(LEDpin1, HIGH);
  digitalWrite(LEDpin2, HIGH);
}                                 // kaikki ovat oikein
```

Sulkujen sisällä arvioitavat lausunnot vaativat yhden tai useamman operaattorin käyttöä:

Vertailuoperaattorit:

```
x == y (x on sama kuin y)
x != y (x ei ole sama kuin y)
x <  y (x on pienempi kuin y)
x >  y (x on suurempi kuin y)
x <= y (x on pienempi tai yhtäsuuri kuin y)
x >= y (x on suurempi tai yhtäsuuri kuin y)
```

ELEKTRONIIKKA

Elektroniikka

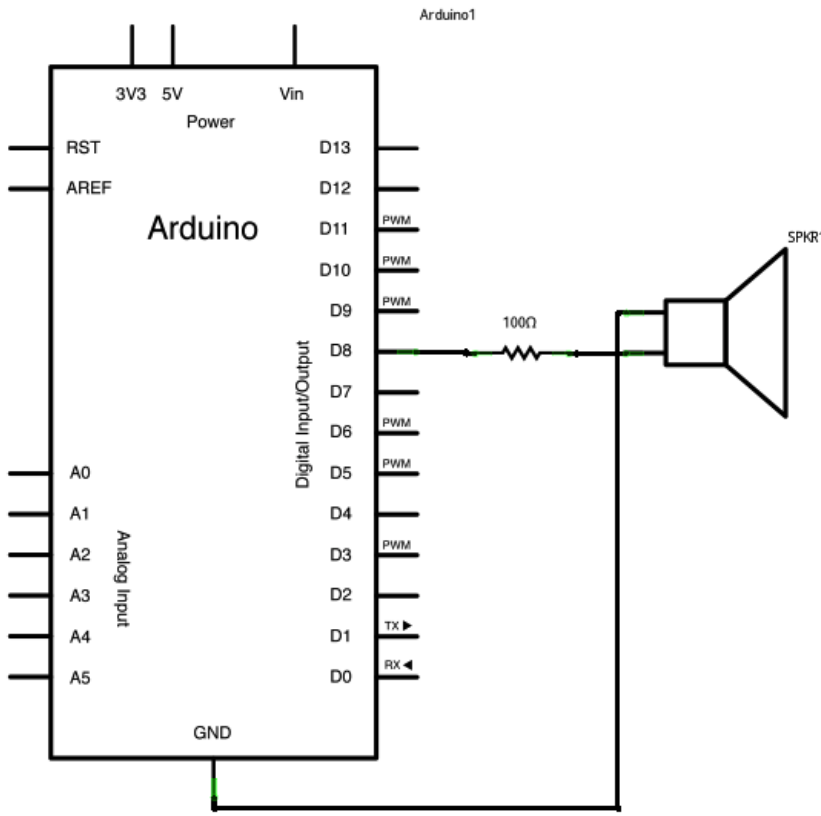
Piezo-summeri

Melodian soittaminen tone() -funktiolla

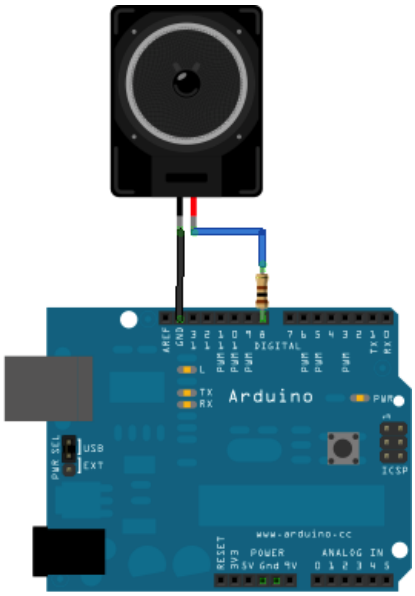
Tätä testiä varten tarvitset Arduinon, piezo-summerin, 100 ohmin resistorin, hyppylankoja ja testipöydän.

Sadan ohmin resistorissa on ruskea, musta, ruskea ja kultainen viiva.

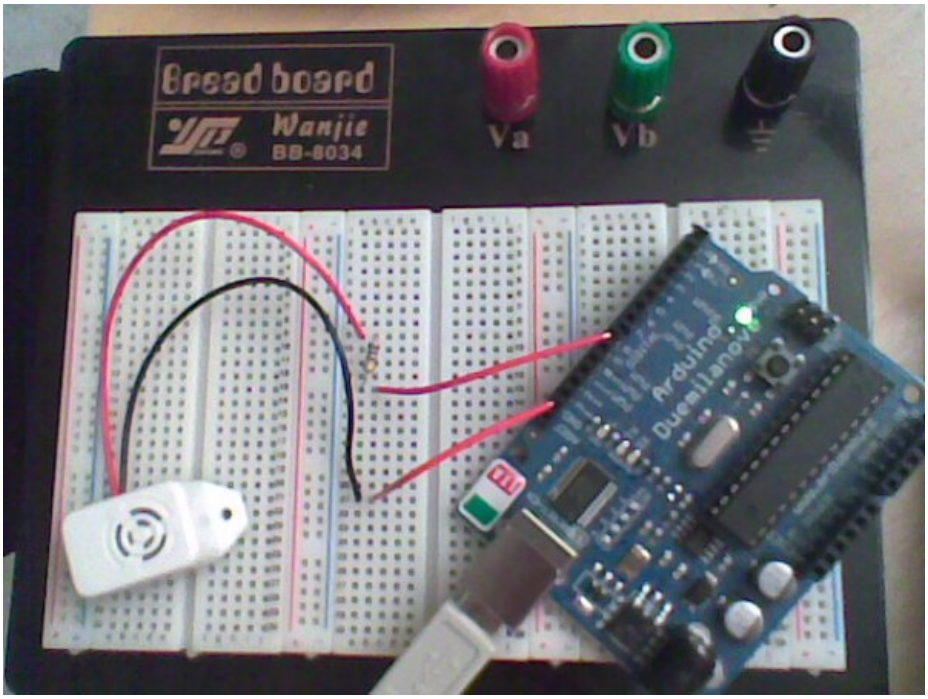
Alla on projektin kytkentäkaavio.



Fritzing-ohjelmalla tehty kuva kytkennöistä.



(Parempi kuva...)



Ensin joudut laatimaan pitching.h -ohjelman. Tässä määritellään nuotit.
Paina ensin uusi välilehti -nappia:

Nimeä uusi tiedosto nimellä pitching.h ja paina OK-nappia.

Kirjoita uuteen välilehteen seuraava koodi:

```
/*************************************************
 * Public Constants
```

```
 ************************************************/

#define NOTE_B0  31
#define NOTE_C1  33
#define NOTE_CS1 35
#define NOTE_D1  37
#define NOTE_DS1 39
#define NOTE_E1  41
#define NOTE_F1  44
#define NOTE_FS1 46
#define NOTE_G1  49
#define NOTE_GS1 52
#define NOTE_A1  55
#define NOTE_AS1 58
#define NOTE_B1  62
#define NOTE_C2  65
#define NOTE_CS2 69
#define NOTE_D2  73
#define NOTE_DS2 78
#define NOTE_E2  82
#define NOTE_F2  87
#define NOTE_FS2 93
#define NOTE_G2  98
#define NOTE_GS2 104
#define NOTE_A2  110
#define NOTE_AS2 117
#define NOTE_B2  123
#define NOTE_C3  131
#define NOTE_CS3 139
#define NOTE_D3  147
#define NOTE_DS3 156
#define NOTE_E3  165
#define NOTE_F3  175
#define NOTE_FS3 185
#define NOTE_G3  196
#define NOTE_GS3 208
#define NOTE_A3  220
#define NOTE_AS3 233
#define NOTE_B3  247
#define NOTE_C4  262
#define NOTE_CS4 277
#define NOTE_D4  294
#define NOTE_DS4 311
#define NOTE_E4  330
#define NOTE_F4  349
#define NOTE_FS4 370
#define NOTE_G4  392
#define NOTE_GS4 415
#define NOTE_A4  440
#define NOTE_AS4 466
#define NOTE_B4  494
#define NOTE_C5  523
#define NOTE_CS5 554
#define NOTE_D5  587
#define NOTE_DS5 622
#define NOTE_E5  659
#define NOTE_F5  698
#define NOTE_FS5 740
#define NOTE_G5  784
#define NOTE_GS5 831
#define NOTE_A5  880
#define NOTE_AS5 932
#define NOTE_B5  988
```

```
#define NOTE_C6  1047
#define NOTE_CS6 1109
#define NOTE_D6  1175
#define NOTE_DS6 1245
#define NOTE_E6  1319
#define NOTE_F6  1397
#define NOTE_FS6 1480
#define NOTE_G6  1568
#define NOTE_GS6 1661
#define NOTE_A6  1760
#define NOTE_AS6 1865
#define NOTE_B6  1976
#define NOTE_C7  2093
#define NOTE_CS7 2217
#define NOTE_D7  2349
#define NOTE_DS7 2489
#define NOTE_E7  2637
#define NOTE_F7  2794
#define NOTE_FS7 2960
#define NOTE_G7  3136
#define NOTE_GS7 3322
#define NOTE_A7  3520
#define NOTE_AS7 3729
#define NOTE_B7  3951
#define NOTE_C8  4186
#define NOTE_CS8 4435
#define NOTE_D8  4699
#define NOTE_DS8 4978
```

Kirjoita sen jälkeen tämä koodi päävälilehteen.

```
/*
  Melody

 Plays a melody

 circuit:
 * 8-ohm speaker on digital pin 8

 created 21 Jan 2010
 by Tom Igoe

This example code is in the public domain.

 http://arduino.cc/en/Tutorial/Tone

 */
 #include "pitches.h"

// notes in the melody:
int melody[] = {
  NOTE_C4, NOTE_G3,NOTE_G3, NOTE_A3, NOTE_G3,0, NOTE_B3, NOTE_C4};

// note durations: 4 = quarter note, 8 = eighth note, etc.:
int noteDurations[] = {
  4, 8, 8, 4,4,4,4,4 };

void setup() {
  // iterate over the notes of the melody:
  for (int thisNote = 0; thisNote < 8; thisNote++) {

    // to calculate the note duration, take one second
    // divided by the note type.
```

```
    //e.g. quarter note = 1000 / 4, eighth note = 1000/8, etc.
    int noteDuration = 1000/noteDurations[thisNote];
    tone(8, melody[thisNote],noteDuration);

    // to distinguish the notes, set a minimum time between them.
    // the note's duration + 30% seems to work well:
    int pauseBetweenNotes = noteDuration * 1.30;
    delay(pauseBetweenNotes);
  }
}

void loop() {
  // no need to repeat the melody.
}
```

Paina upload-nappia ja Arduino soitaa piezo-summerilla melodian: 

Servomoottori

Esimerkki servomoottorin liittämisestä Arduinoon ja ohjelmoinnista.

Sensori

Esimerkki sensorin liittämisestä Arduinoon ja sen ohjelmoinnista.

ROBOTTI

Robotti

Kokonaisen robotin rakentaminen!

ROBOTIN OHJELMOINTI

Ohjelmointi

TEKIJÄT

Lisenssi

Arduino.cc

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