

IV Escola Brasileira de Ensino de Física

Desenvolvendo projetos interativos nas aulas de Física com Arduino

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Programa

Segunda: Conhecer o arduino e instalar os programas necessários.

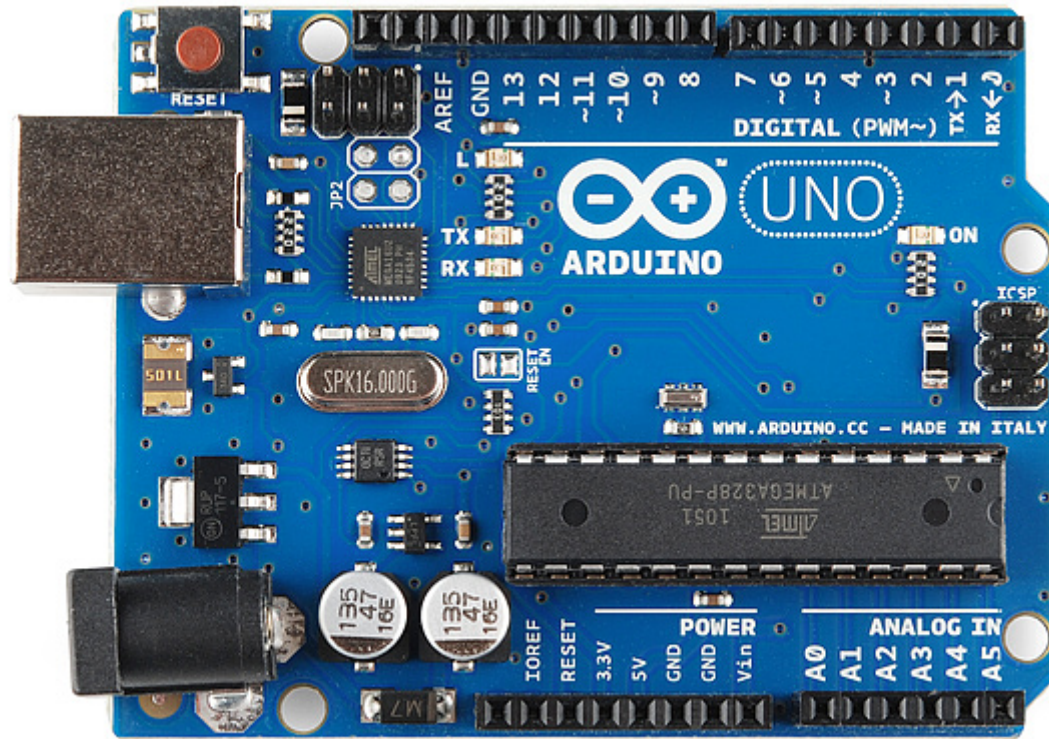
Terça: Conhecer os programas.

Quarta: Mão na massa: Mecânica e Termodinâmica.

Quinta: Mão na massa: Termodinâmica e Eletricidade.

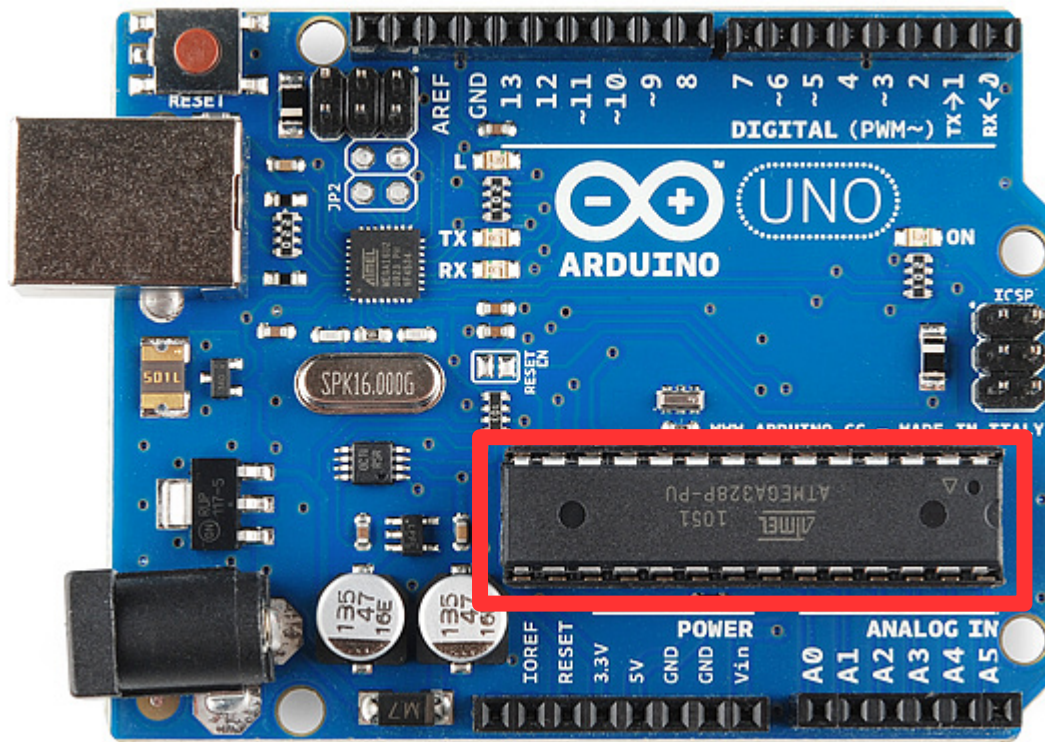
O que é o Arduino?

Arduino é um computador pequeno utilizado para prototipagem eletrônica. Foi desenvolvido especialmente para designers e artistas plásticos, ou seja, deve ser fácil de utilizar.



O que ele tem de especial?

Processador / Microcontrolador: É o cérebro do Arduino. Na maioria são usados os microcontroladores ATMEL de 16MHz.



O que ele tem de especial?

Portas Digitais: Enviam ou detectam a presença de uma tensão (5V) na porta (**HIGH**), ou não (**LOW**).



O que ele tem de especial?

Portas Digitais PWM: Portas capazes de enviar um sinal com ciclo reduzido, serve para emular uma saída analógica.

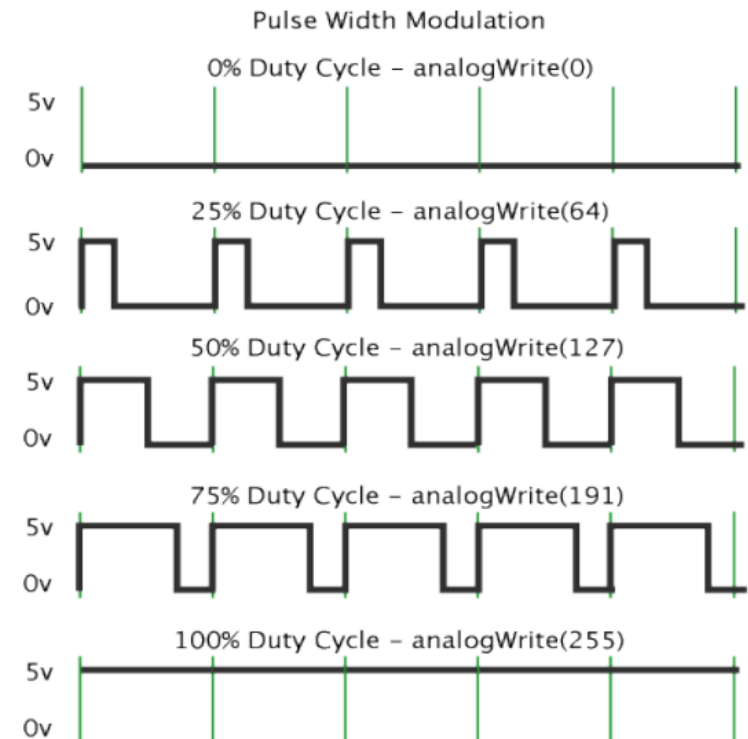
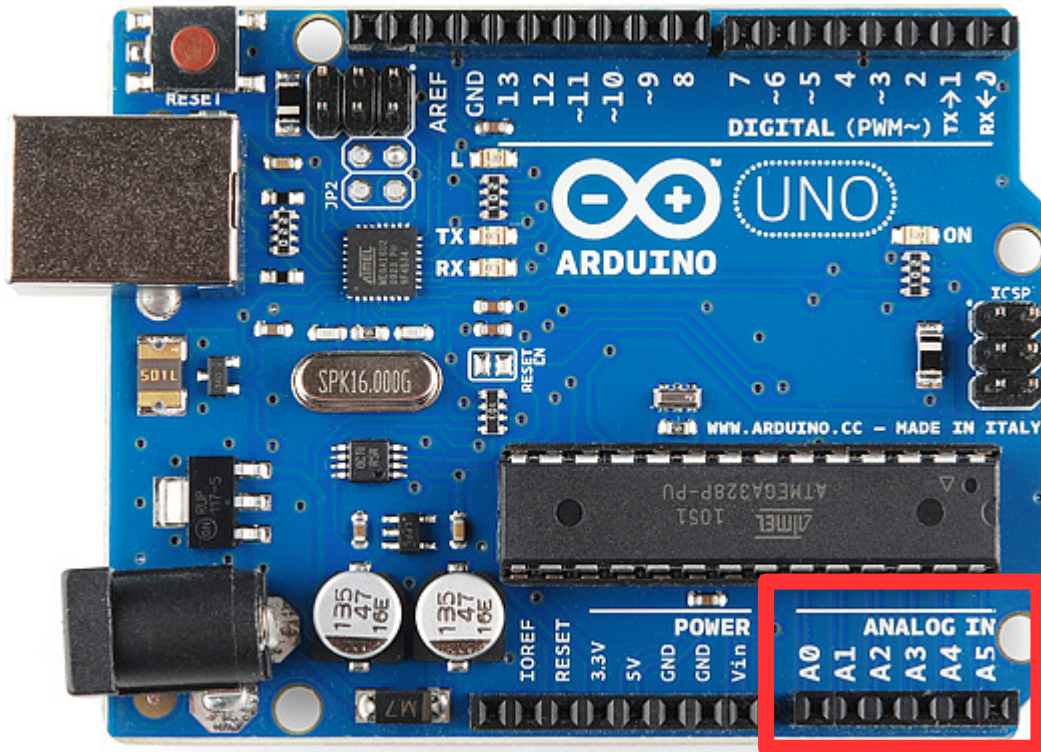


Fig 1. Tensão aplicada nas portas PWM em função do tempo.

O que ele tem de especial?

Portas Analógicas: Portas capazes de APENAS receber sinais com tensão que variam entre 0V e 5V.











- Precisão de 10 bits.

$$2^{10} = 1024$$

$$5V/1024 = 4,9mV$$

Modelos e suas especificações

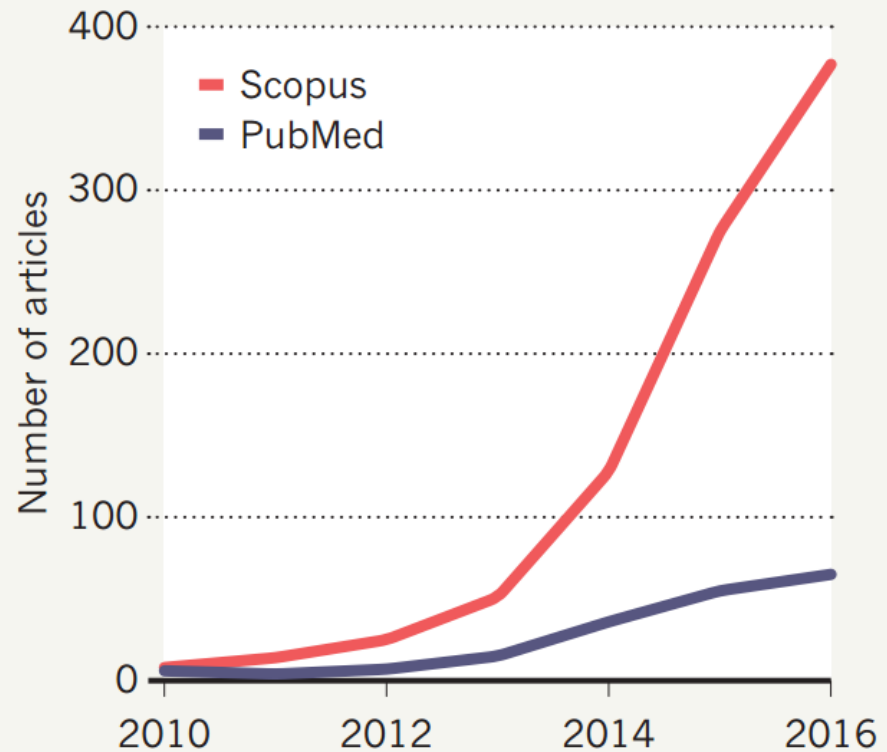
	Arduino Uno	Arduino Mega2560	Arduino Leonardo	Arduino Due	Arduino ADK	Arduino Nano	Arduino Pro Mini	Arduino Esplora
								
Microcontrolador	ATmega328	ATmega2560	ATmega32u4	AT91SAM3X8E	ATmega2560	ATmega168 (versão 2.x) ou ATmega328 (versão 3.x)	ATmega168	ATmega32u4
Portas digitais	14	54	20	54	54	14	14	-
Portas PWM	6	15	7	12	15	6	6	-
Portas analógicas	6	16	12	12	16	8	8	-
Memória	32 K (0,5 K usado pelo bootloader)	256 K (8 K usados pelo bootloader)	32 K (4 K usados pelo bootloader)	512 K disponível para aplicações	256 K (8 K usados pelo bootloader)	16 K (ATmega168) ou 32K (ATmega328), 2 K usados pelo bootloader	16 K (2k usados pelo bootloader)	32 K (4 K usados pelo bootloader)
Clock	16 Mhz	16 Mhz	16 Mhz	84 Mhz	16 Mhz	16 Mhz	8 Mhz (modelo 3.3v) ou 16 Mhz (modelo 5v)	16 Mhz
Conexão	USB	USB	Micro USB	Micro USB	USB	USB Mini-B	Serial / Módulo USB externo	Micro USB
Conector para alimentação externa	Sim	Sim	Sim	Sim	Sim	Não	Não	Não
Tensão de operação	5v	5v	5v	3.3v	5v	5v	3.3v ou 5v, dependendo do modelo	5v
Corrente máxima portas E/S	40 mA	40 mA	40 mA	130 mA	40 mA	40 mA	40 mA	-
Alimentação	7 - 12 Vdc	7 - 12 Vdc	7 - 12 Vdc	7 - 12 Vdc	7 - 12 Vdc	7 - 12 Vdc	3.35 - 12 V (modelo 3.3v), ou 5 - 12 V (modelo 5v)	5v

Por que usar Arduino?

- **Barato;**
- **Fácil;**
- **Seguro;**
- **Resistente;**
- **É Tendência.**

MARCH OF THE MINI-COMPUTERS

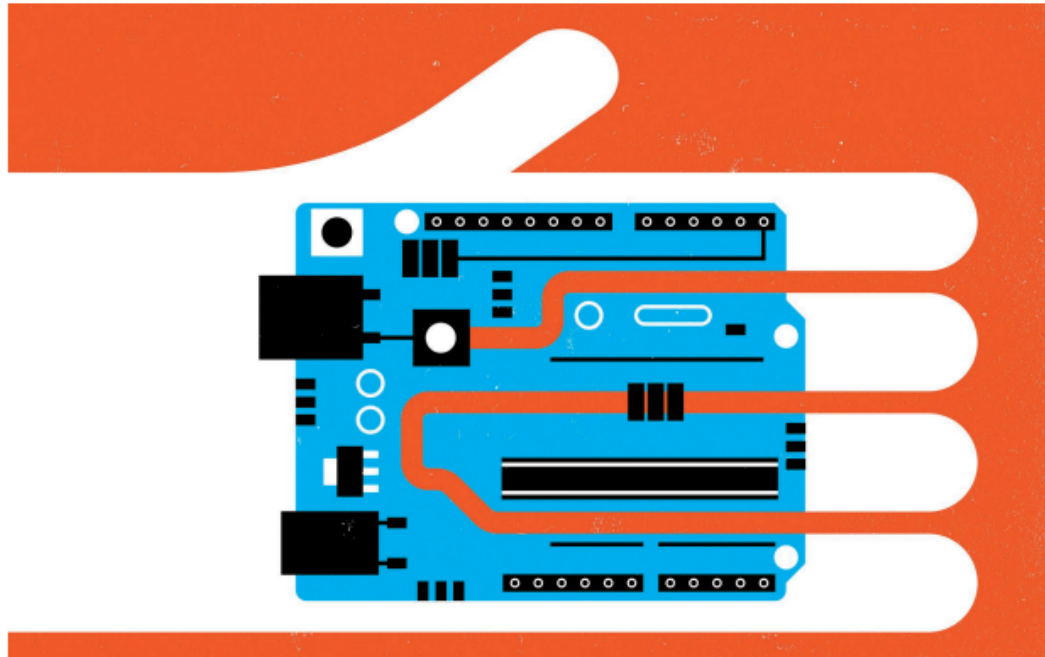
The number of papers including the terms 'Raspberry Pi' or 'Arduino' has been rising in databases of scientific publications.



AGE OF THE ARDUINO

A booming market for small, cheap 'single-board computers' offers researchers a helping hand in fields such as automation, networking and data collection.

ILLUSTRATION BY THE PROJECT TWINS



BY DANIEL CRESSEY

A research subject watches a brush slowly stroking a rubber hand on a table in front of her, while her own hand — hidden from view — experiences the same stimulation. Eventually, the subject starts to think that rubber hand is her own.

This rubber-hand illusion is a trick of the mind. But it is also a trick of design. Normally, the illusion is created by people who have carefully practised using brushes to stroke the real and rubber hands simultaneously. But Isa Rao, a psychology PhD student at the University of Glasgow, UK, who uses this set-up to gain insight into how people relate to their own bodies, has built an automated rig that delivers the stimuli without a trained assistant. At its heart is an Arduino microcontroller.

Arduinos are one of a growing number of low-cost, stripped-down, and highly

configurable computing devices that have transformed the field of homebrew and do-it-yourself electronics. Increasingly, they are transforming the research community too (see 'March of the mini-computers'). Available for as little as £4 (US\$5) for the basic circuit board, or about £50 for a kit including power supply, case and cables, these systems have little in the way of bells and whistles, and the learning curve can be steep. Yet Arduinos and similar devices, such as the Raspberry Pi, pack considerable power on their diminutive boards, providing tremendous opportunities for automation, networking and data collection and analysis.

For researchers, those features can translate into benefits both economic and practical. Users can shoehorn the systems into tiny spaces, deploy them without monitors or keyboards, buy them in bulk, and pack them into autonomous devices that need to be

taken to (and transmit data from) remote field locations. All it takes is a little ingenuity.

NO EXPERIENCE NECESSARY

Although researchers have been customizing computers and integrating them into their experiments for decades, the market for small, cheap, 'single-board computers' has boomed in recent years. The Raspberry Pi — a fully fledged computer that can run the Linux operating system — appeared in 2012; by September 2016, 10 million had been sold. Arduinos — technically, programmable microcontrollers rather than computers — have been similarly popular since their launch in 2005. Off-the-shelf accessories for these devices include cameras, motion sensors, thermometers and Bluetooth adaptors. There's even an all-in-one system developed for an outreach project on the International Space Station; the system combines a gyroscope, ▶

Onde comprar?

Tem tempo para esperar?



Onde comprar?

Não tem?



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O que é necessário para fazer experimentos de Física?

I. Um Arduino

II. Protoboard e fios (cabo de rede são perfeitos)

III. Ferro de Solda e Solda (~R\$30)

IV. Tubo Termoretrátil

V. Resistores

VI. LEDs

VII. Sensores (A depender do experimento)

VIII. Um computador ou display

IX. Disposição

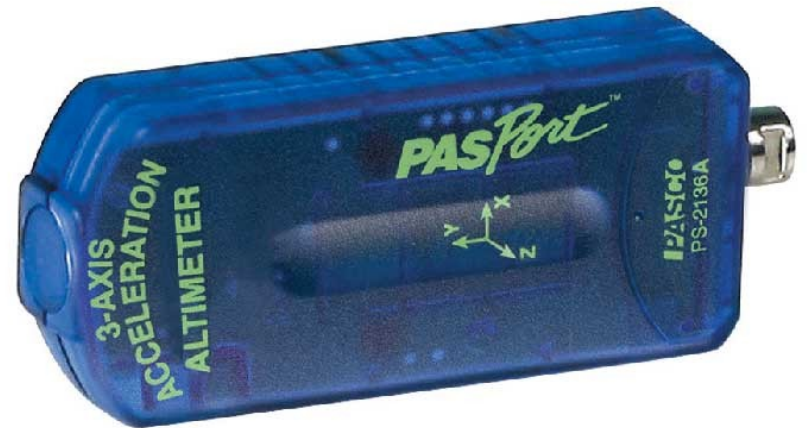
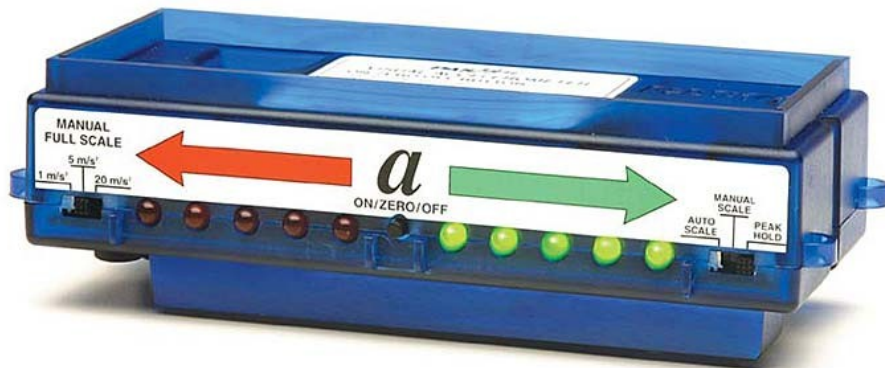
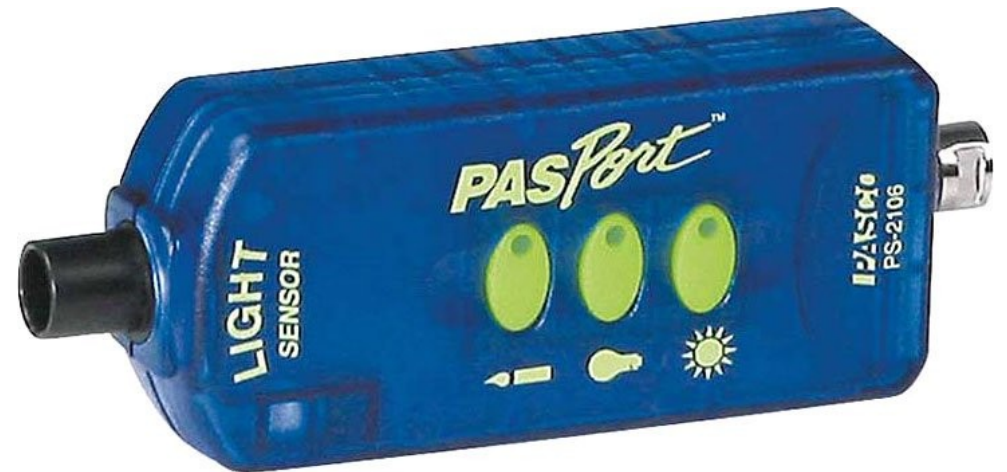
É caro?

	China	Brasil
Arduino UNO	~ R\$ 15	~ R\$ 40
Arduino Nano	~ R\$10	~ R\$ 45
Arduino Mega	~ R\$ 30	~ R\$ 80
Sensores	Entre R\$ 5 e R\$ 30	Entre R\$ 15 e R\$ 150

O que dá para fazer?



O que dá para fazer?



Nem tudo são flores



Experimentos das mais diversas áreas

Mecânica

Termodinâmica

Ondas e Óptica

Eletromagnetismo



**Não se preocupe com técnica.
Tenha o foco na Física.**

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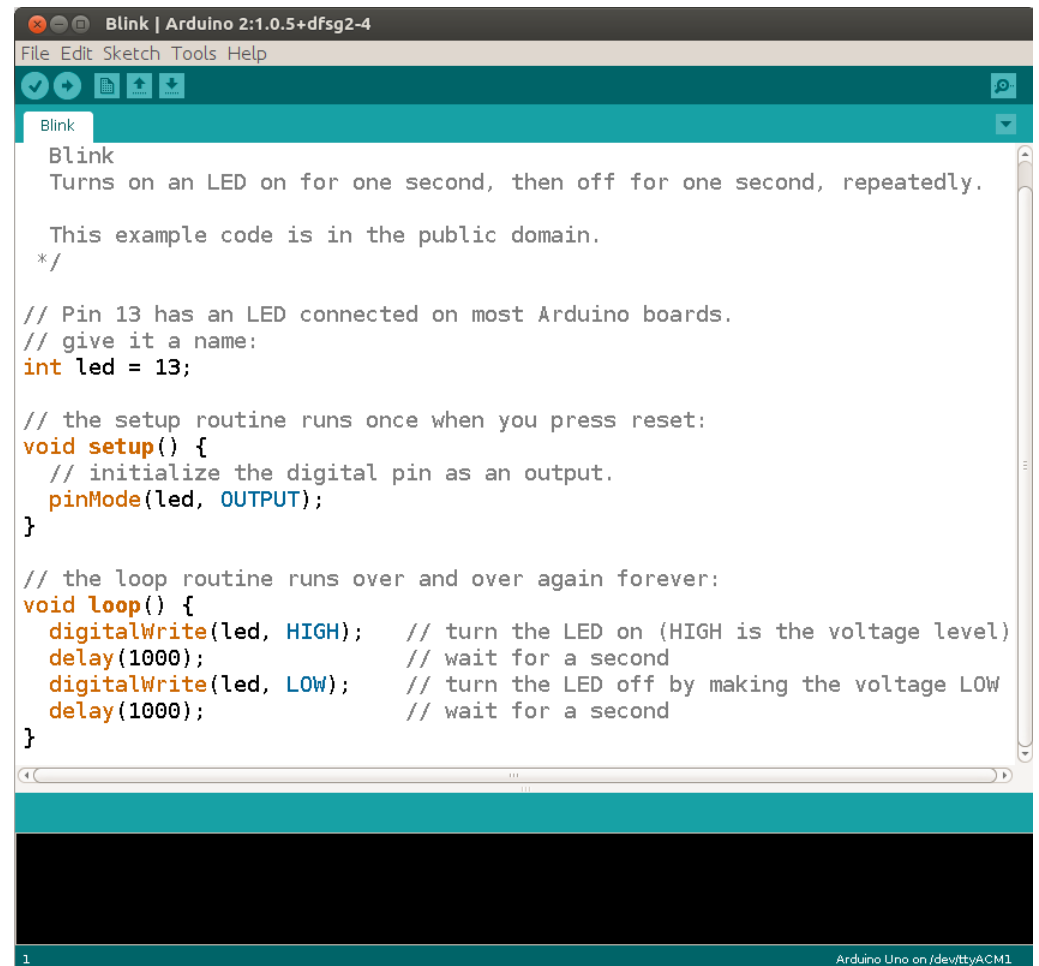
<http://dx.doi.org/10.1590/1806-9126-rbef-2017-0166>

PRODUTOS E MATERIAIS DIDÁTICOS

**Sistema *photogate* de seis canais analógicos
para laboratórios didáticos de física**

Os Aplicativos

IDE do Arduino
Onde é feita a
programação do
arduino. A linguagem
de programação é
Wiring (igual a C).



The screenshot shows the Arduino IDE interface with the 'Blink' sketch open. The code is as follows:

```
Blink | Arduino 2:1.0.5+dfsg2-4
File Edit Sketch Tools Help
Blink
Blink
Turns on an LED on for one second, then off for one second, repeatedly.

This example code is in the public domain.
*/

// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

// the setup routine runs once when you press reset:
void setup() {
  // initialize the digital pin as an output.
  pinMode(led, OUTPUT);
}

// the loop routine runs over and over again forever:
void loop() {
  digitalWrite(led, HIGH); // turn the LED on (HIGH is the voltage level)
  delay(1000);             // wait for a second
  digitalWrite(led, LOW);  // turn the LED off by making the voltage LOW
  delay(1000);             // wait for a second
}

1
Arduino Uno on /dev/ttyACM1
```

Os Aplicativos

Ardublock

Esqueça a programação.

The screenshot displays the Ardublock software interface. On the left, a vertical sidebar contains various functional categories: Controle, Pinos, Testes, Matemática, Variáveis, Outros Dispositivos, Comunicação, Armazenamento, Códigos, Kit da Tinker, DFRobot, Seed Studio, Mechanics, Thermodynamics, Optic, and Others sensors. The main workspace features a menu bar with options: Novo, Salvar, Salvar como, Abrir, Enviar para o Arduino, and Monitor Serial. A central yellow vertical bar is labeled 'sempre' (always) and 'faça' (do). The workspace contains a sequence of blocks: 1. 'Install GY' block with parameters Model: GY-80, Device: Accelerometer, and Prec: 2000. 2. A loop structure starting with 'mensagem2' and 'inprime', followed by a 'junte' block, a 'Read GY' block with Device: Accelerometer and Var: X, and a 'nova linha' block with value 'FALSO'. 3. A second loop structure with 'mensagem2', 'inprime', 'junte', 'Read GY' (Device: Accelerometer, Var: Y), and 'nova linha' (FALSO). 4. A third loop structure with 'mensagem2', 'inprime', 'junte', 'Read GY' (Device: Accelerometer, Var: Z), and 'nova linha' (VERDADEIRO). The bottom status bar includes 'Salvar como imagem...', 'Ir para o Web Site', and 'v 21040826 (beta)'.

Os Aplicativos

ViewDuino

Coleta e análise de dados

The screenshot displays the ViewDuino software interface, which is used for data collection and analysis from an Arduino. The main window is titled "ViewDuino - Interface de dados para Arduino" and features a menu bar with "Arquivo", "Ferramentas", "Tabela", and "Janela". A toolbar contains various icons for file operations and data visualization. The central area is divided into several panels:

- Table:** A table with 3 columns and 18 rows of data. The columns are labeled 1, 2, and 3. The data values are as follows:

	1	2	3
1	0.0	1002	820
2	0.05	156	140
3	0.1	686	946
4	0.15	210	200
5	0.2	552	308
6	0.25	780	334
7	0.3	100	882
8	0.35	730	1002
9	0.401	104	262
10	0.451	218	520
11	0.501	716	756
12	0.551	282	940
13	0.601	720	128
14	0.651	232	892
15	0.701	34	62
16	0.751	170	644
17	0.802	52	154
18	0.852	28	772
- Configuração (Configuration):** A dialog box with "Selecione a porta:" set to "/dev/ttyS0" and "Selecione o baud rate:" set to "9600". It has "Cancel" and "OK" buttons.
- &Gráfico (Graph):** A line graph showing two data series, "Dado 1" (blue) and "Dado 2" (red), plotted against "Nome do eixo X" (0 to 20) and "Nome do eixo Y" (0 to 600). The graph is titled "Título do Gráfico".
- &Histograma (Histogram):** A histogram showing the distribution of data points, with the x-axis ranging from 0 to 1,000 and the y-axis from 0 to 6. The bars are green.
- Item list:** A panel on the right with checkboxes for "Legend", "Dado 2", "Dado 1", and "Grid", all of which are checked.
- Terminal:** A text area at the bottom showing a stream of data points: "19.254;256;564", "19.305;184;464", "19.355;426;364", "19.405;940;754", "19.455;988;660", "19.505;900;42", "19.555;544;754", "19.605;598;478".

Instalando os programas

<http://TEACHDUINO.UFSC.BR>