

The logo for Wiring++ is displayed within an orange rounded rectangle. The text "Wiring++" is in a white, italicized, sans-serif font, with a small "TM" trademark symbol to the upper right of the second plus sign.

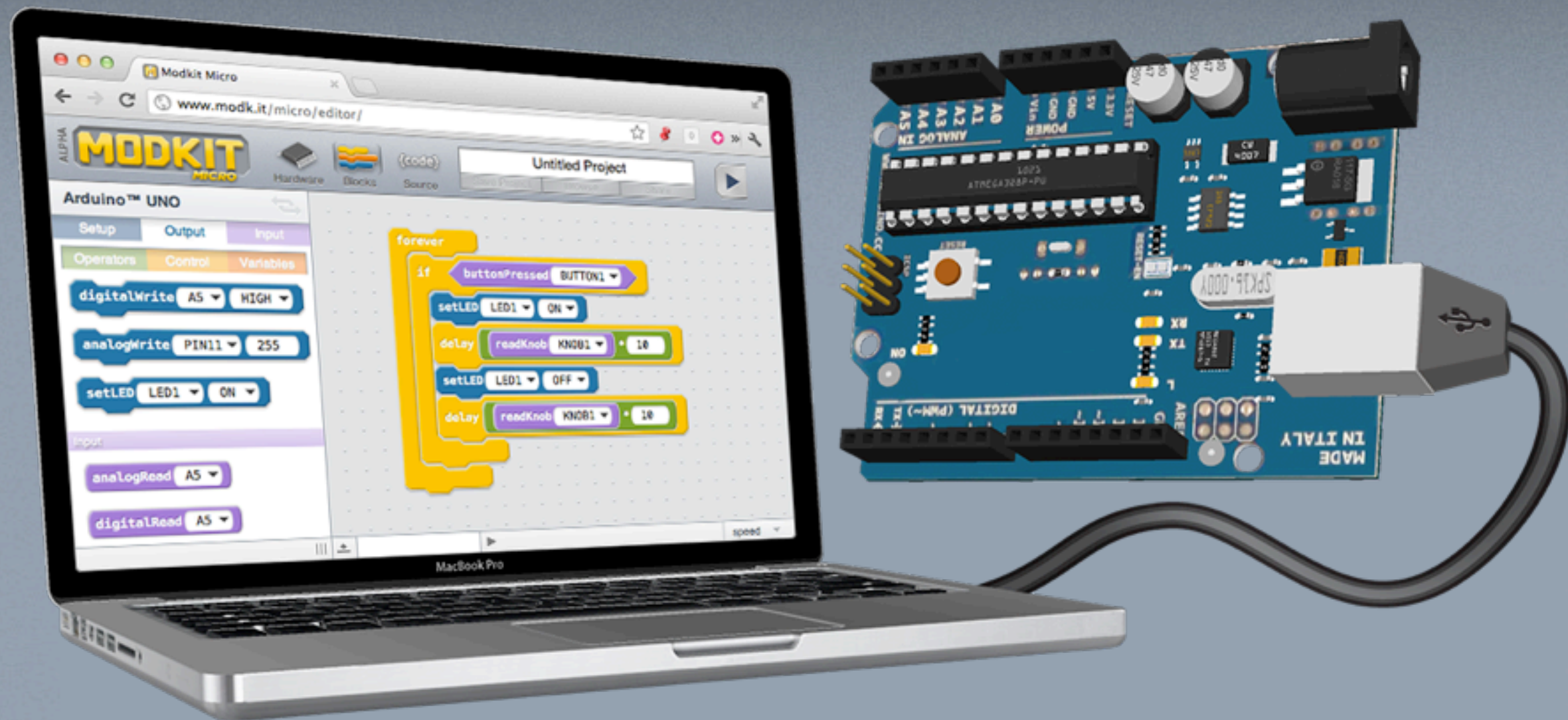
# *Wiring++*<sup>TM</sup>

The future of microcontroller programming

[ed@modk.it](mailto:ed@modk.it)



# About Modkit



Programming & engineering *should* be:  
Accessible, Affordable, Engaging, and Fun!



the beginning...



The Wiring Project



the beginning...

## The Wiring Project:

who?      Hernando Barragan

where?    Interaction Design Institute of Ivrea (Italy)

when?     Summer 2003



# the beginning...



Wiring is an open-source programming framework for microcontrollers enabling anyone to program all kinds of interactive objects, spaces and physical experiences.



# the beginning...



Board + Language + Editor



# the beginning...

Artes, Diseño,  
Arquitectura e Ingeniería Mecánica de La Universidad de Los  
Andes (Colombia) - Diseño Visual, Universidad de Caldas (Colombia) - Diseño de  
Medios Interactivos, Universidad ICESI (Colombia) - Interaction Design Institute Ivrea (Italy) -  
Fachbereich Design-FHPotsdam (Germany) - Design|Media Arts, University of California Los Angeles UCLA (USA) -  
University of the Arts, Bremen (Germany) - ENSCI Les Ateliers, Paris (France) - San Francisco Art Institute (USA) - Carnegie  
Mellon School of Design (USA) - Rhode Island School of Design RISD, Digital Media Program (USA) - Universität der Künste, Berlin  
(Germany) - Pratt School of Architecture, (USA) - Royal College of Art, London, (UK) - HyperWerk, Basel, (Switzerland) - University of Hongik,  
Seoul (Korea) - Ateneo de Manila University, Manila (Philippines) - Visual Communication Design Department at Istanbul Birci University (Turkey) - Oslo  
School of Architecture and Design (Norway) - IAMAS Institute of Advanced Media Arts and Sciences, Tokio, (Japan) - Università di Verona, Verona (Italy) -  
Centre Georges Pompidou Museum, Paris (France) - School of Arts, University of Western Sydney (Australia) - UCL London's Global University (UK) - Art and  
Design Graduate Program, Purdue University (USA) - University of Manchester (UK) - Dalhousie University (Canada) - Architecture at The University of Sydney  
(Australia) - Georgia Tech (USA) - Media Arts and Sciences, MIT Media Laboratory (USA) - The University of Kansas (USA) - Ravensbourne College of Design and  
Communication (UK) - Railway Procurement Agency, Dublin (Ireland) - University of Illinois at UrbanaChampaign (USA) - University of Plymouth studying Digital Art and  
Technology (UK) - Keio University, Tokio (Japan) - College of Fine Arts, Seoul National University, Seoul (Korea) - **Wiring's** University of Toronto **Reach** (Canada) - Scottsdale Museum of Contemporary Art, **By 2005** Scottsdale  
(USA) - Leiden University's Media Technology, Leiden (The Netherlands) - Arquitectura, La Salle Universitat Ramon Llull (Spain) - ART SENSITIF Association, (France) -  
Cologne International School of Design (Germany) - Newcastle University (UK) - Dept. of Visual & Multimedia Design, Konkuk University Hwayangdon, Seoul (Korea) -  
School of Art and Design University of Illinois at Chicago (USA) - Technische Fachhochschule Berlin, University of Applied Sciences, Berlin (Germany) - Industrial Design  
and Architecture, Stevens Institute in Hoboken, New Jersey (USA) - NOKIA, Helsinki (Finland) - Université de Paris Sud (France) - Università' di Roma Tor Vergata, Roma  
(Italy) - National Chiao Tung University at Taiwan (China) - Design School in Kolding (Denmark) - Wimbledon School of Art in London (UK) - Interactive Media at  
Goldsmiths College University of London (UK) - IshikawaNamikiKomuro Lab / University of Tokyo (Japan) - Tokyo University of Technology (Japan) - University  
of California San Diego (USA) - Louisiana State University (USA) - Alberta College of Art + Design (Canada) - Yale School of Architecture (USA) - University  
of Florida (USA) - VRIab in Switzerland (Switzerland) - Michigan State University (USA) - Human Technology Research Gr. Advanced Technology  
Development Lab. Matsushita Electric Works, Ltd., Tokyo (Japan) - MAS ETH ARCH/CAAD, Zurich (Switzerland) - Media Design, Hongik  
University, Seoul (Korea) - Art Center Nabi, Seoul (Korea) - Tokyo University of Technology (Japan) - RAPLAB, ETH Hönggerberg  
(Switzerland) - Institute of Design, Umea University (Sweden) - Art Center, Los Angeles (USA) - Design, Seoul National  
University, Seoul (Korea) - Design, Bezalel academy of art and design Jerusalem (Israel) - Design, California  
Tech, CALTECH (USA) - IUAV Facoltà di Design e Arti, Venecia (Italy) - Department of Mechanical  
Engineering, Villanova University (USA).

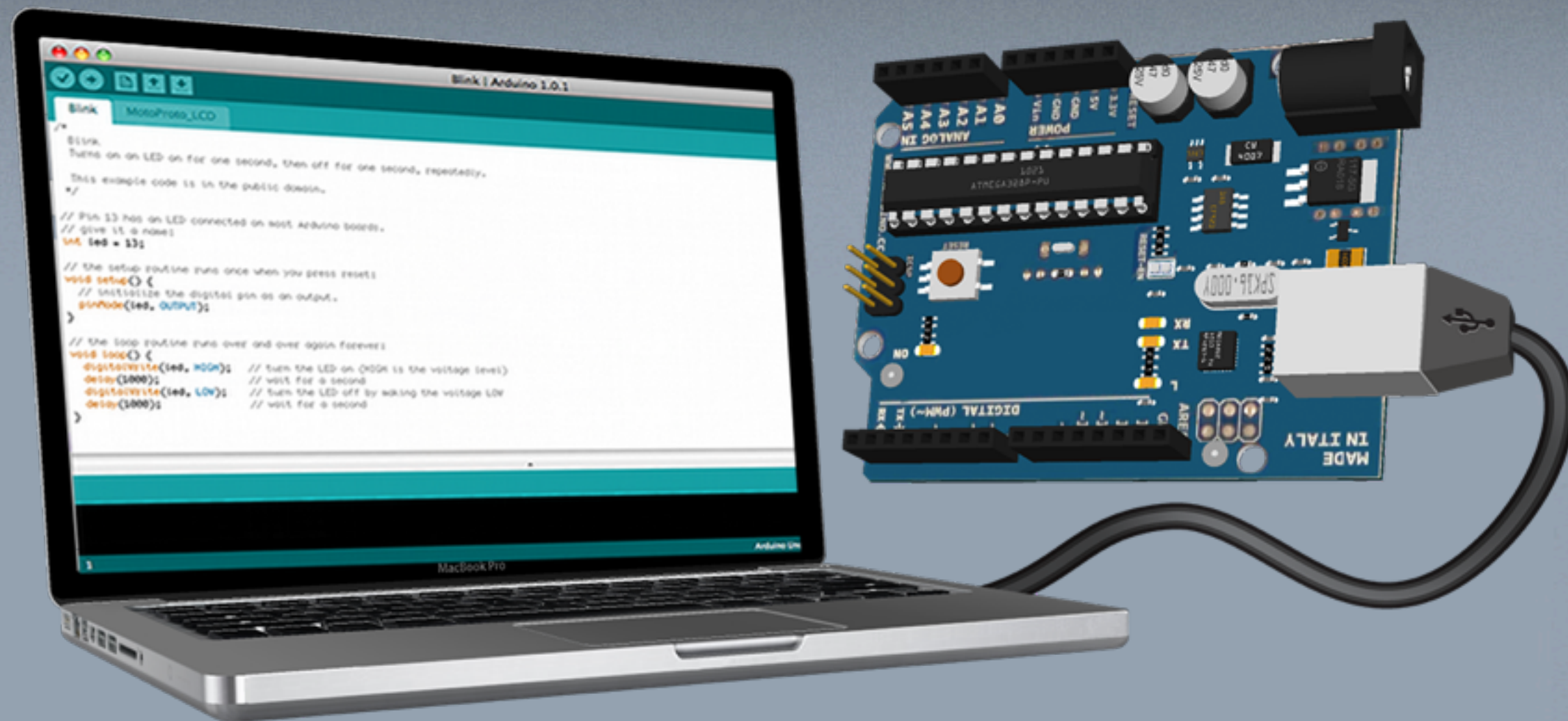


the beginning...

But wait.. Isn't that just like Arduino?



# the beginning...



Arduino also consists of a set of boards, a language, and an editor.



# the beginning...

Arduino was built around the Wiring project of Hernando Barragan... I don't think Arduino would exist without Wiring and I don't think Wiring would exist without Processing.

-Casey Raes (Processing co-creator)



# the beginning...

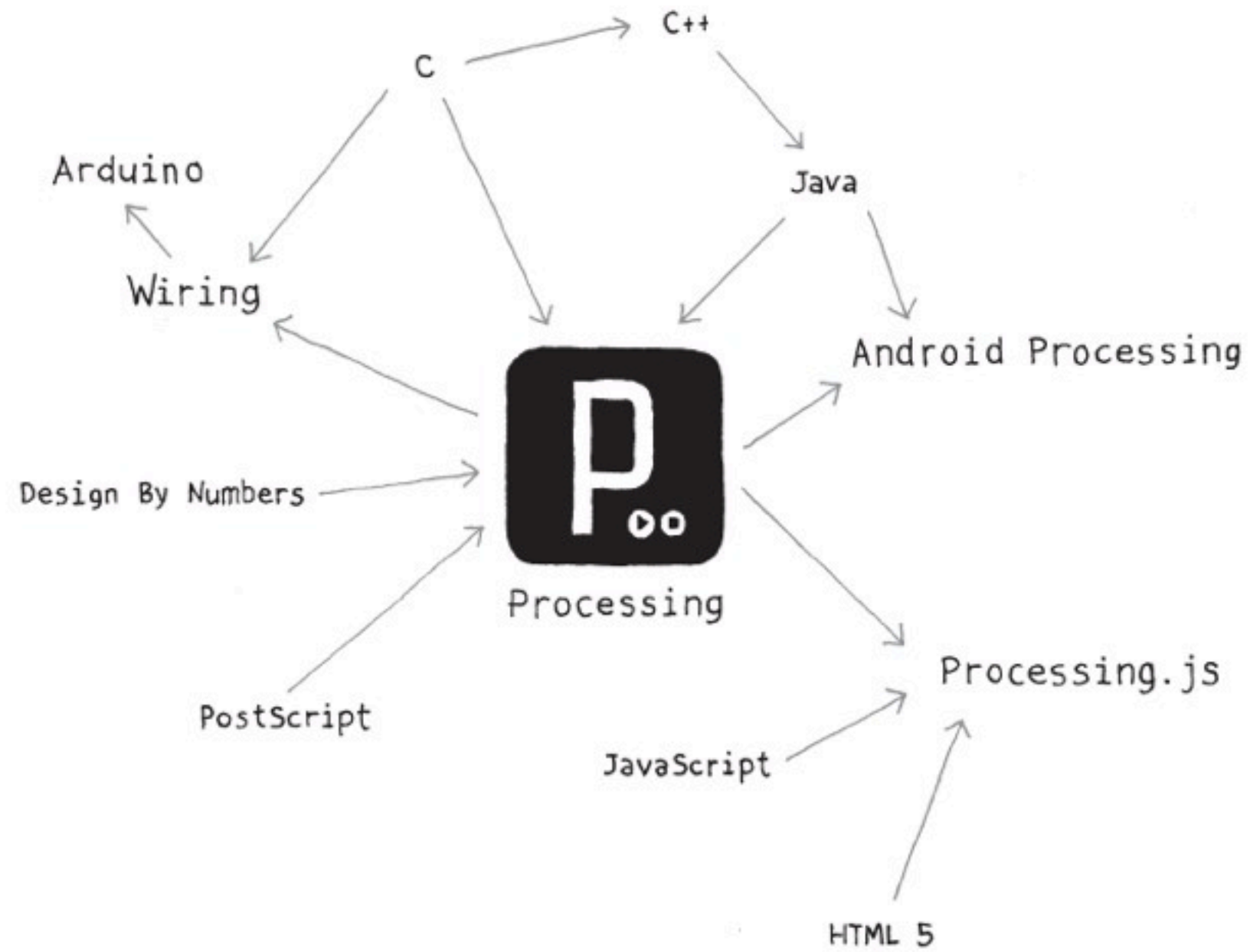


Figure 1-4. Processing has a large family of related languages and programming environments.



10 years later...



Wiring turns 10 this summer!

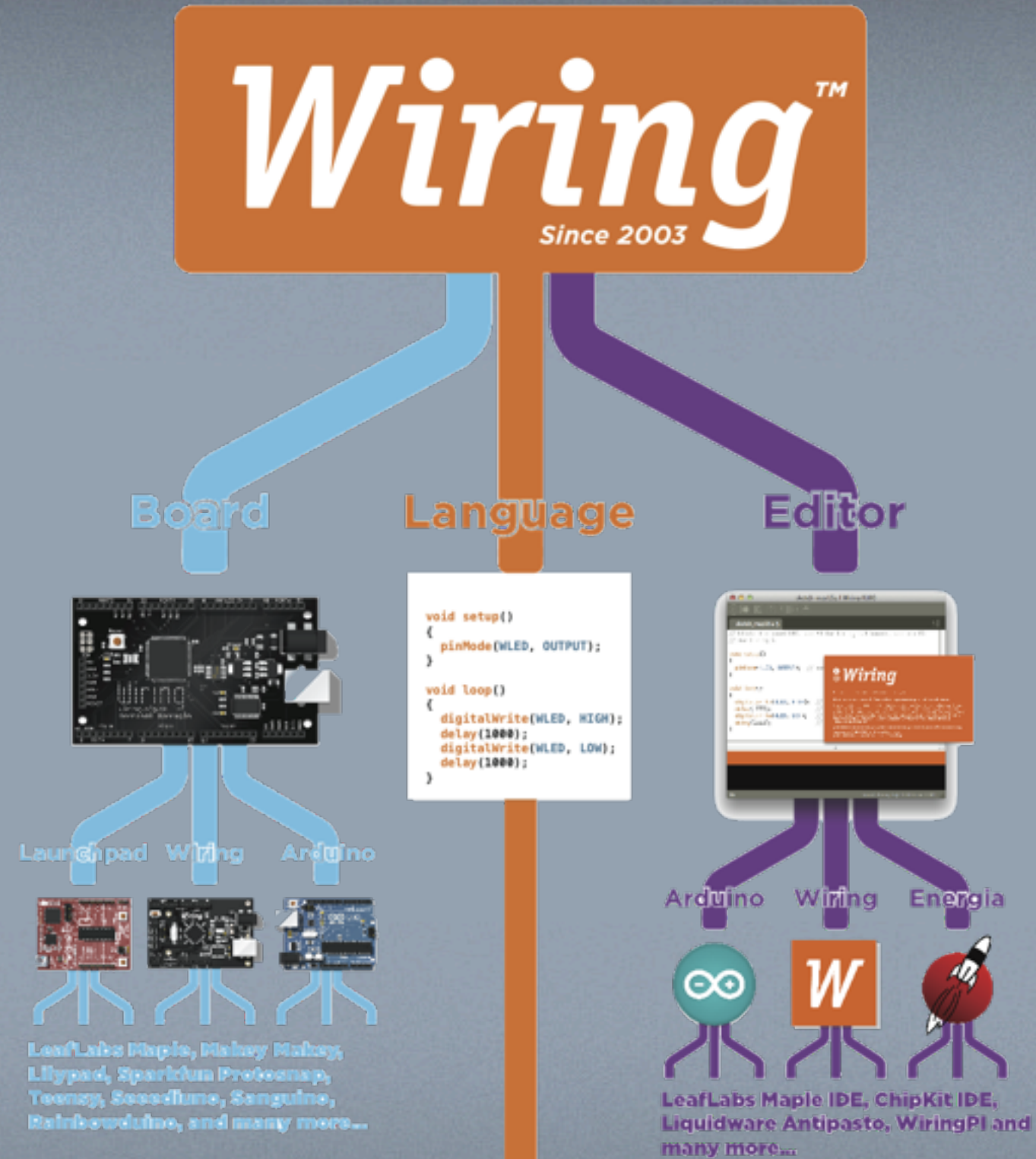


the now...

What's happened with the Wiring language?



the now...





the now...

Not much has happened with the Wiring language!



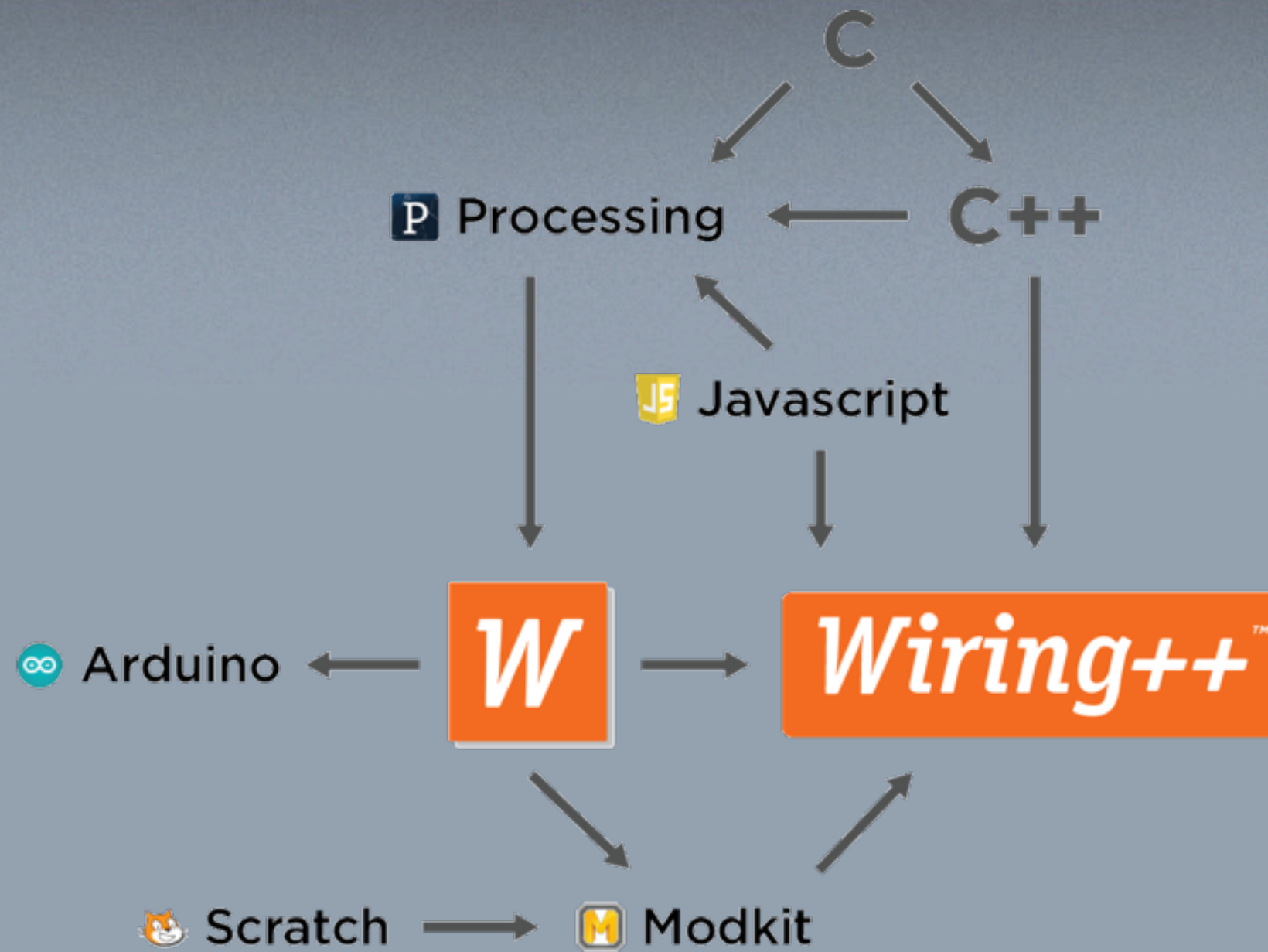
# the now: setup/loop...

```
void setup(){  
    setupSomething();  
}
```

```
void loop(){  
    if(checkSomething()){  
        doSomething();  
    }  
}
```



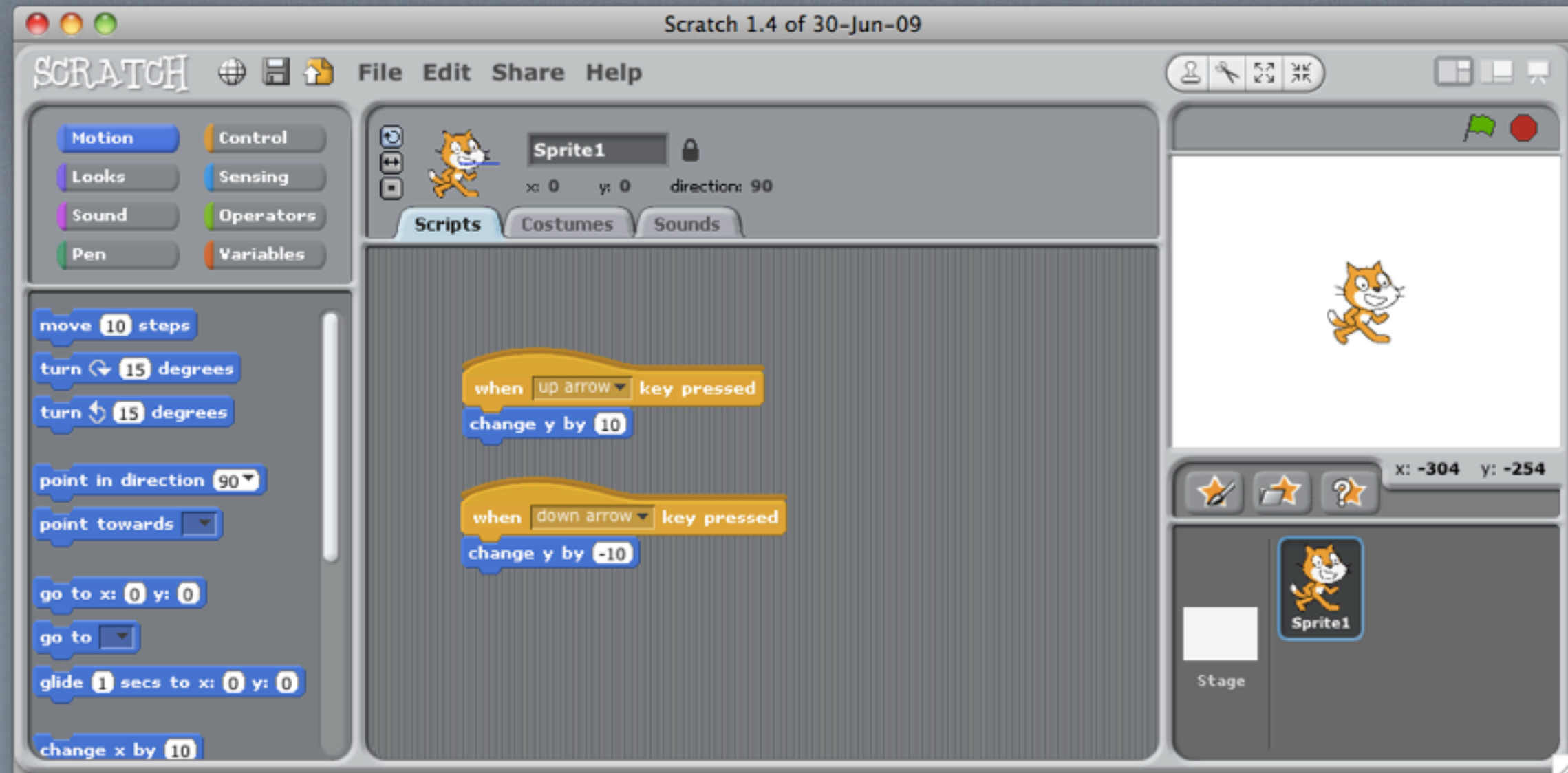
the future...



Extending the family...



the future...



Scratch-like threads and Events?



## the future: events...

```
GlobalEvents{EVENT1,EVENT2};
```

```
void events() {  
    when(EVENT1) {  
        doSomething();  
    }  
    when(TWOSSEC) {  
        doSomethingElse();  
    }  
}  
void setup() {  
    broadcast(EVENT1);  
}
```



# the future: threads...

```
void threads() {  
    thread(THREAD_NAME) {  
        while (1) {  
            checkAndUpdate()  
            delay(100);  
        }  
    }  
}  
  
void setup(){  
    THREAD_NAME.start();  
}
```



## the future: built-in events...

Named events can be user generated or built-in events such as START which fires on startup after setup().

```
void events() {  
    when(START) {  
        doSomething();  
    }  
}
```



# the future: threading and event implementation...

Threading and event model needed to be very lightweight to fit on extremely constrained devices (MSP430-512b/ram)

~12 bytes ram/thread

~80 bytes flash/thread



# the future: Dual C/C++ APIs...

## Wiring++ API (C++ syntax)

```
Serial1.println("Wiring++");  
PIN13.pinMode(OUTPUT);  
PIN13.digitalWrite(HIGH);
```

## Wiring Classic API (C syntax)

```
println(Serial1, "Wiring++");  
pinMode(PIN13, OUTPUT);  
digitalWrite(PIN13, HIGH);
```



## the future: pins as objects...

The Wiring++ API is centered around Pins-as-objects so rather than only being able to pass a pin to a function, Pins themselves have built-in functionality.

```
DigitalIoPin relayPin = PIN13;  
relayPin.pinMode(OUTPUT);  
relayPin.digitalWrite(HIGH);
```



## the future: pins as objects - method chaining...

By introducing pins as objects we also gain the ability to add method chaining to all pin methods that would otherwise have no return value: e.g.

```
PIN13.pinMode(OUTPUT).digitalWrite(HIGH);
```



## the future: pins as objects - interfaces...

Component authors can specify what functionality a valid pin parameter will have by naming a given Pin Interface -- e.g. PWM (compiler errors vs undefined runtime behavior):

```
void component::method(PwmPin pin, uint8_t volume){  
    pin.analogWrite(volume*25);  
}
```



## the future: component events...

Component events allow users to write code that respond to component-based-events that trigger automatically.

```
#include "Button.h"
Button button = Button(12);

void events() {
    when(button.PRESSED) {
        doSomething();
    }
}
```



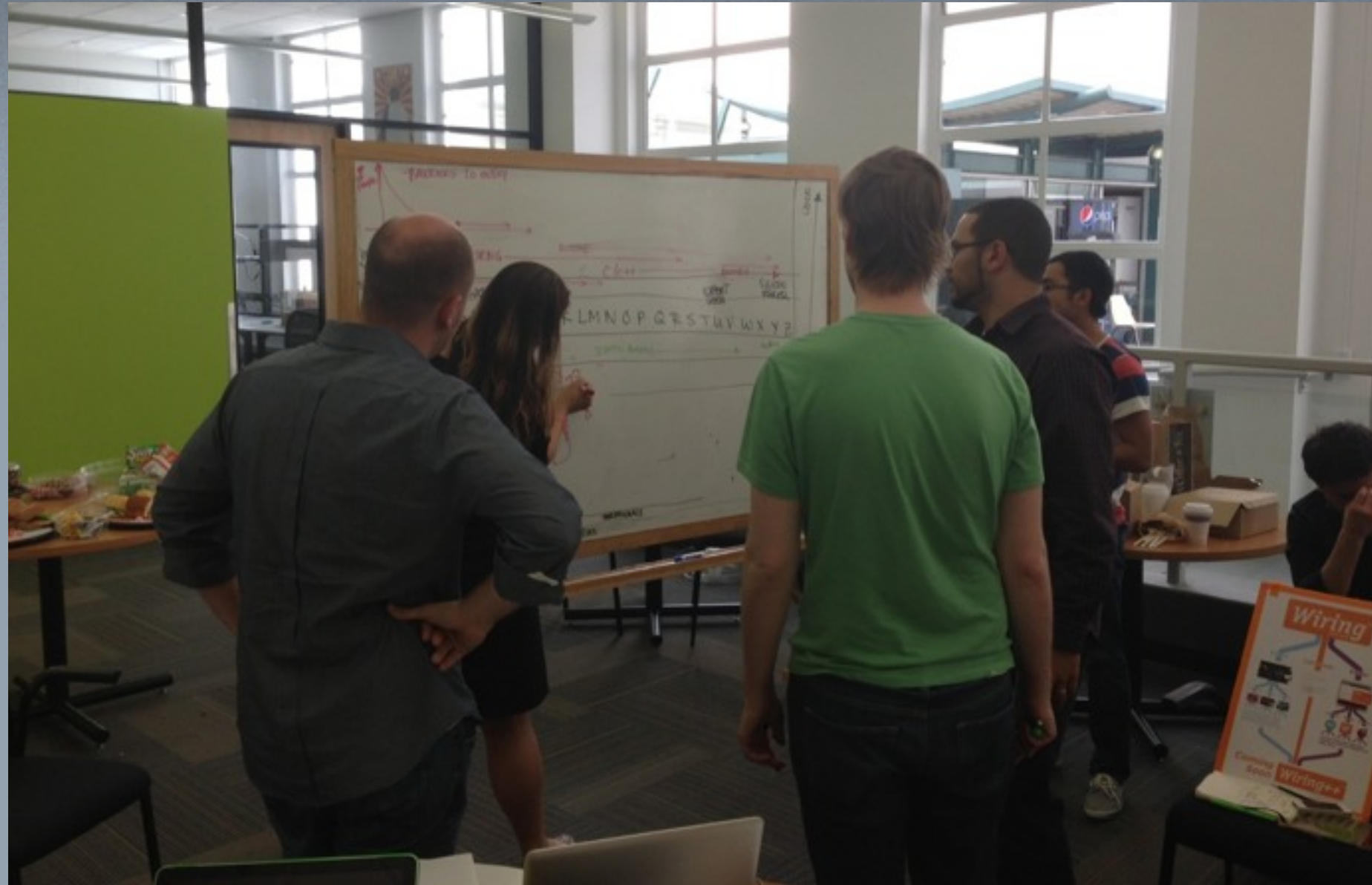
## the future: Wiring++ licensing...

Wiring has traditionally had an LGPL (Lesser GNU Public License aka Library GNU Public License)

But many businesses and end-user products are being developed around the Wiring APIs. To better support these uses, we're moving to an MIT/BSD license.



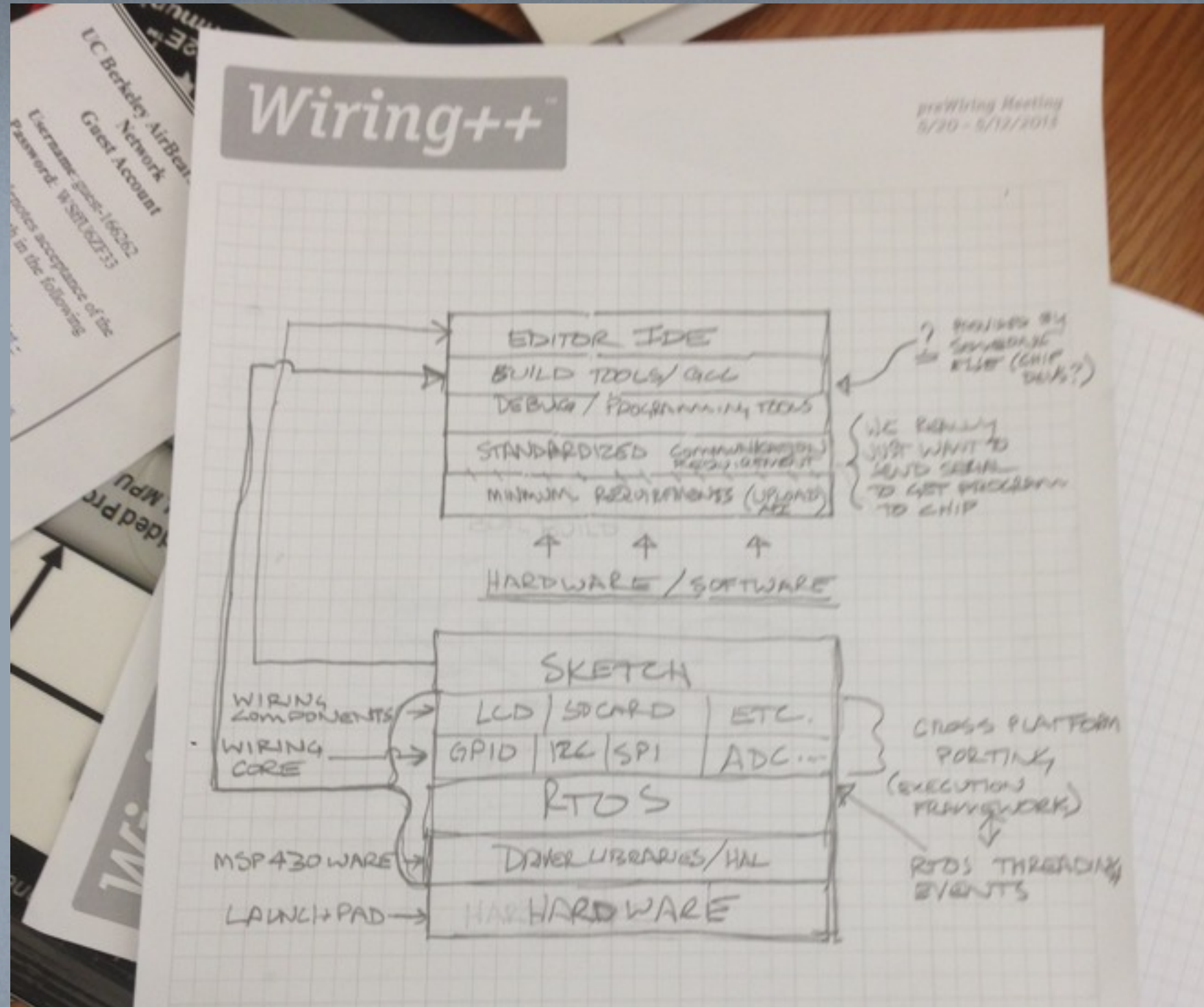
who?



Wiring + Modkit + Texas Instruments

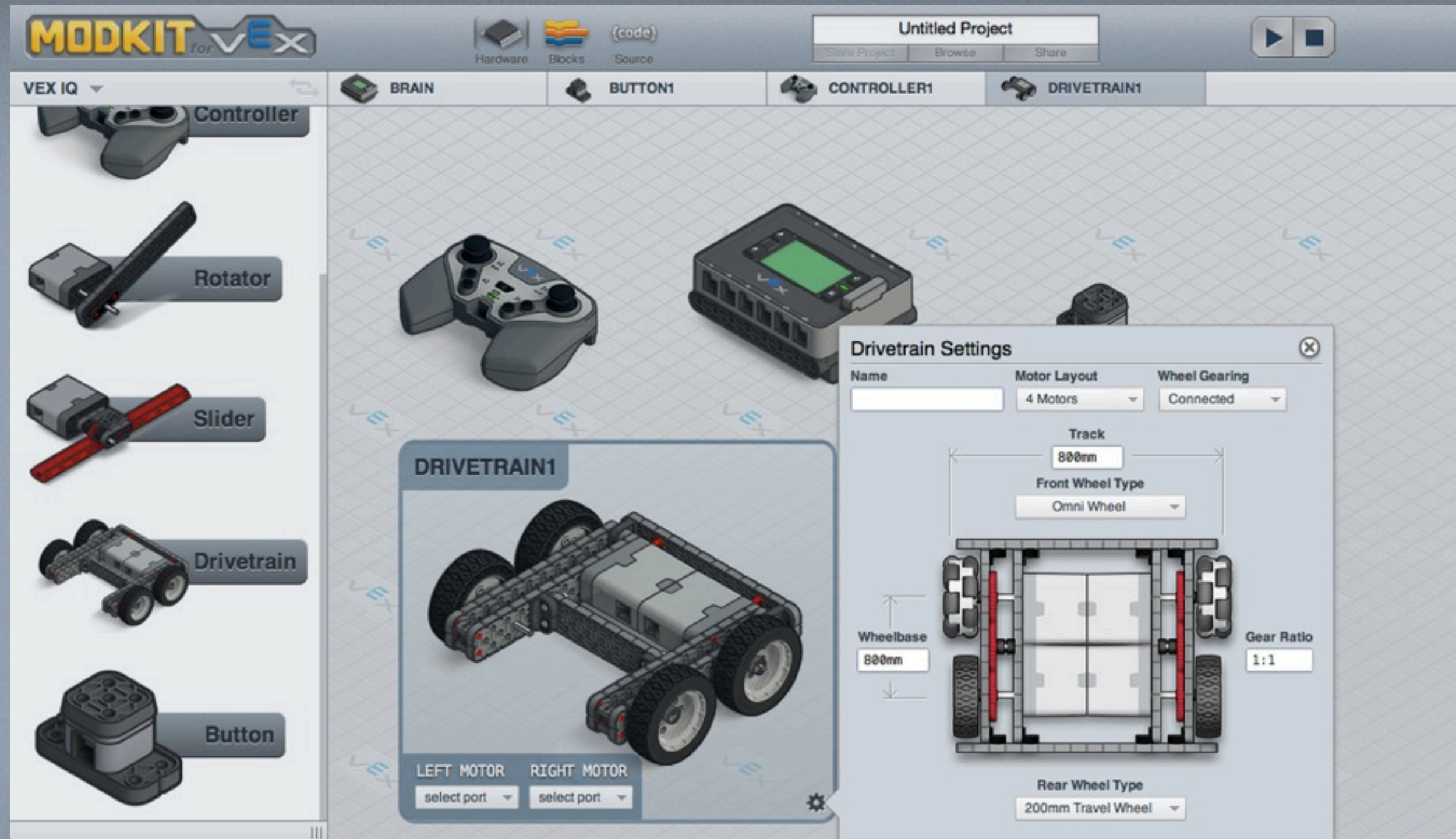


# who?



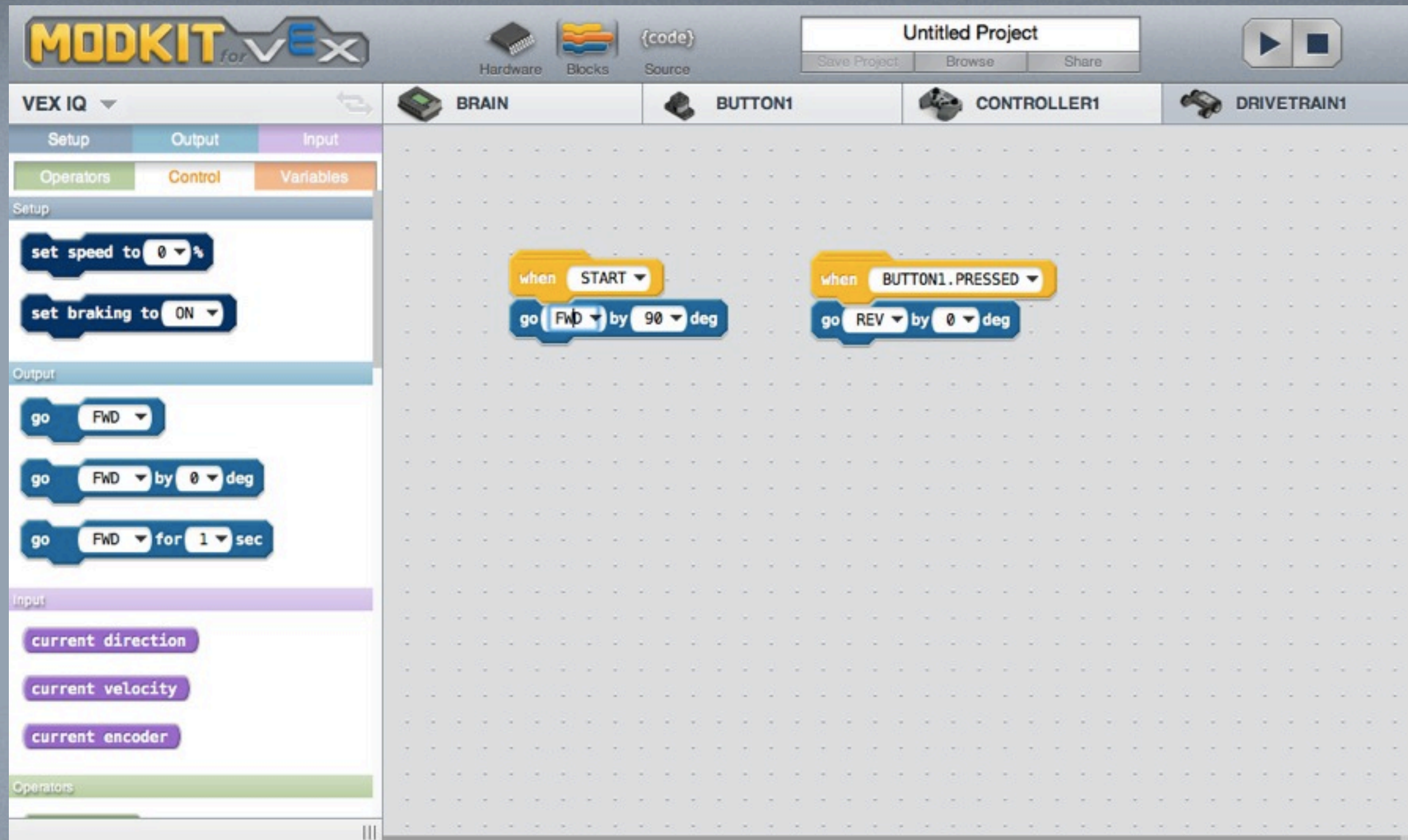


# why?





# why?





thanks...

Wiring team: Hernando Barragan, Brett Hagman, Alex Brevig

TI team: Adrian Fernandez, Robert Wessels