MaKey MaKey Advanced Guide

This Tutorial is **Retired**!

This tutorial covers concepts or technologies that are no longer current. It's still here for you to read and enjoy, but may not be as useful as our newest tutorials.

View the updated tutorial: Makey Makey Classic Hookup Guide

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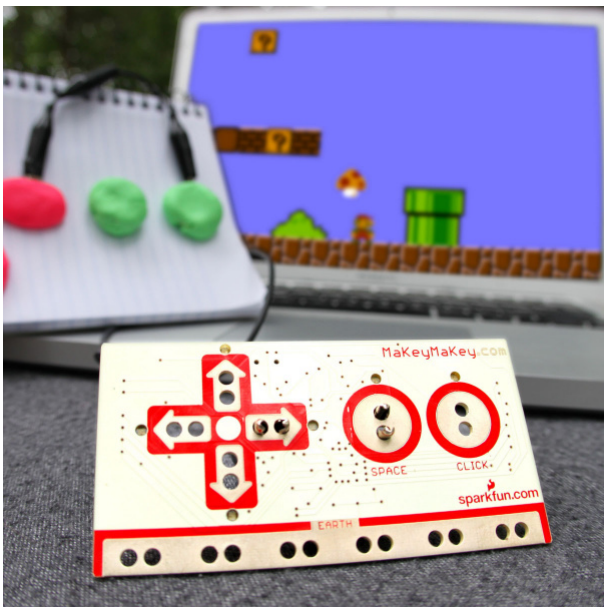
Introduction

Previously on Getting Started with the MaKey MaKey we discussed how to make your standard banana space bar. But what if you want to make a full-on banana piano, and the default MaKey MaKey key presses don't fit your needs? Among its many magical characteristics, the MaKey MaKey is easily reprogrammable, so you can customize the key-mapping to fit your project.



In this tutorial we'll show you how to use Arduino -- the most popular embedded development environment out there -- to reprogram the MaKey MaKey and modify which inputs press which keyboard or mouse control. We'll also talk a bit about that mysterious **output header**, which you can use to turn the MaKey MaKey into more than just an input device.

Please Note: This tutorial only applies to Makey Makeys purchased from SparkFun or a SparkFun Distributor that have the SparkFun logo printed on the board. Variants of the Makey Makey purchased from other sources may not work with the instructions laid out in this guide.

Suggested Reading

Before following along with this tutorial, we highly recommend you read through our Getting Started with the MaKey MaKey tutorial. That guide will help get you fully up-and-running with the MaKey MaKey, leading you from driver installation to making your first key.

Beyond that tutorial, here are some related tutorials we'd recommend reading as well:

- What is an Arduino? -- An overview of Arduino, from the IDE to the boards to the language.
- How to Install the Arduino IDE -- You won't get too far in this tutorial without having Arduino installed, this tutorial will help you through the process.
- Logic Levels -- Learn about the difference between HIGH, LOW, 0V, 5V, on, off, etc.
- Using GitHub -- The MaKey MaKey Arduino files are hosted on GitHub, where we keep the most up-to-date files.

Installing the Arduino Addon

Before you can program the MaKey MaKey using Arduino, you need to **download and install the Arduino IDE** (integrated development environment). Check out our Installing Arduino IDE tutorial for help with that. From there you can access the Arduino application by double-clicking (using the MaKey MaKey!?) the Arduino application.

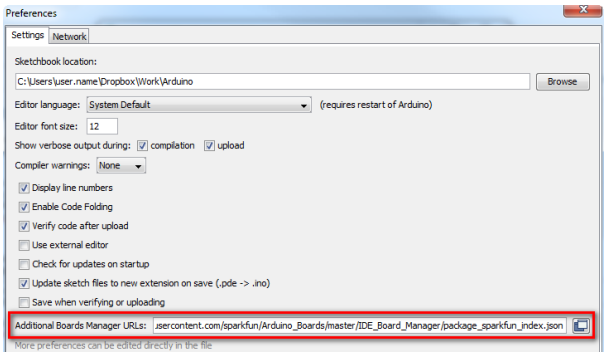
Installing the Addon Using the Arduino Board Manager

The MaKey MaKey addon for Arduino adds an entry to the Arduino "Boards" list tailored to the MaKey MaKey. Arduino 1.6.4 introduced the **Board Manager** feature, which makes installing board addons as easy as a few button-clicks.

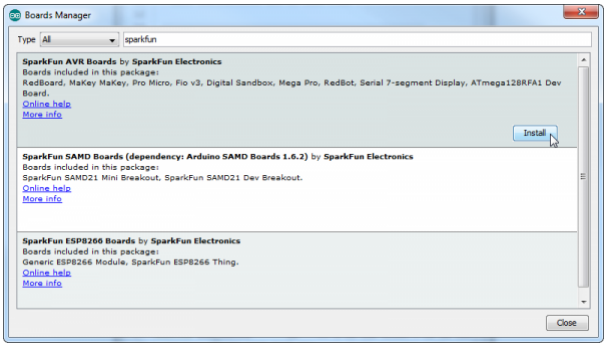
Arduino 1.6.4 or later requried. Stuck using an older version? Click here.

To install the MaKey MaKey board, first open your Arduino preferences (**File** > **Preferences**). Then find the **Additional Board Manager URLs** text box, and paste the below link in:

```
https://raw.githubusercontent.com/sparkfun/Arduino_Boards/master/IDE_Board_Manager/package_sparkfun_index.json
```



Then hit "OK", and travel back to the **Board Manager** menu. You should (but probably won't) be able to find a new entry for **SparkFun AVR Boards**. If you don't see it, close the board manager and open it again. ¯_(ツ)_/¯.



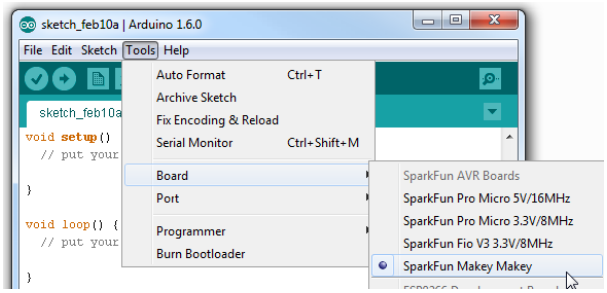
Select **Install**, and wait a couple seconds while the addon downloads and installs.

Programming the MaKey MaKey

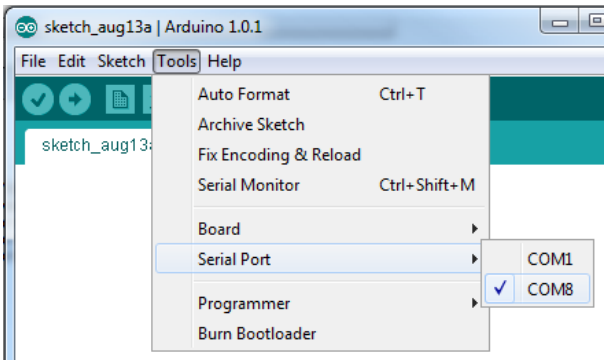
You're just about ready to modify the firmware driving the MaKey MaKey. But first there are a few settings we need to adjust.

Board and Port Selection

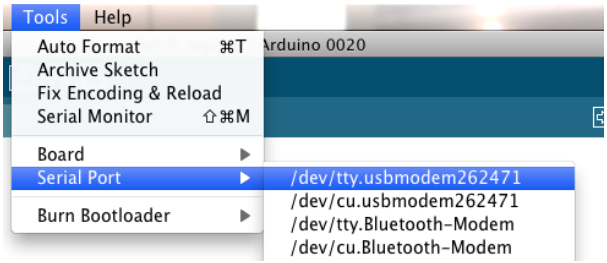
The addon you installed will add a "MaKey MaKey" option to the **Tools > Board** menu within the Arduino IDE. Go ahead and select that.



You'll also need to set the **Serial Port**. When you plug in the MaKey MaKey it enumerates as a communication device and gets assigned a COM port (Windows users, you'll need drivers installed, see here). **Select the MaKey MaKey's COM port** under the **Tools > Serial Port** menu in Arduino. For most users, there'll be only one port to choose from. If there are two, unplug and replug the MaKey MaKey in, observing which COM port disappears and reappears.



On a Mac, the Serial Port will come in the form of "/dev/tty.usbmodem":



Modifying the Code

Onto the code. You can find the most up-to-date MaKey MaKey source code at its Github home (check out our Using GitHub tutorial for help downloading). Or click the link below to download it directly. It's another ZIP file, so don't forget to extract it!

DOWNLOAD THE MAKEY MAKEY FIRMWARE

There are two pieces to the MaKey MaKey code: the main file (currently **makey_makey_1_4_2.ino**) and the **settings.h** file. Open the *.ino* file with your Arduino IDE, *settings.h* will open up in a tab up top.

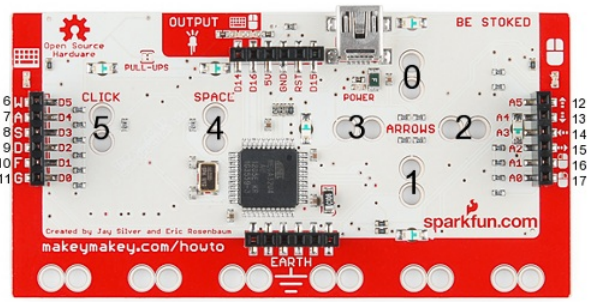
Generally you'll only need to futz with *settings.h*. This is where all of the keys are defined, and there are a few more advanced options to play with the filters, and mouse movement speed. Here's what it'll look like by default:

```
#include "Arduino.h"

/*
////////////////////////////////////////////////////////////////////////
// KEY MAPPINGS: WHICH KEY MAPS TO WHICH PIN ON THE MAKEY MAKEY BOARD? //
////////////////////////////////////////////////////////////////////////

  - edit the keyCodes array below to change the keys sent by the MaKey MaKey for each input
  - the comments tell you which input sends that key (for example, by default 'w' is sent by pin
D5)
  - change the keys by replacing them. for example, you can replace 'w' with any other individua
l letter,
    number, or symbol on your keyboard
  - you can also use codes for other keys such as modifier and function keys (see the
    the list of additional key codes at the bottom of this file)

*/

int keyCodes[NUM_INPUTS] = {
  // top side of the makey makey board

  KEY_UP_ARROW,      // up arrow pad
  KEY_DOWN_ARROW,    // down arrow pad
  KEY_LEFT_ARROW,    // left arrow pad
  KEY_RIGHT_ARROW,   // right arrow pad
  ' ',               // space button pad
  MOUSE_LEFT,        // click button pad

  // female header on the back left side

  'w',                // pin D5
  'a',                // pin D4
  's',                // pin D3
  'd',                // pin D2
  'f',                // pin D1
  'g',                // pin D0

  // female header on the back right side

  MOUSE_MOVE_UP,      // pin A5
  MOUSE_MOVE_DOWN,    // pin A4
  MOUSE_MOVE_LEFT,    // pin A3
  MOUSE_MOVE_RIGHT,   // pin A2
  MOUSE_LEFT,         // pin A1
  MOUSE_RIGHT         // pin A0
};

////////////////////////////
// NOISE CANCELLATION /////
////////////////////////////
#define SWITCH_THRESHOLD_OFFSET_PERC  5    // number between 1 and 49
                                           // larger value protects better against noise oscilla
tions, but makes it harder to press and release
```

```
                                        // recommended values are between 2 and 20
                                        // default value is 5

#define SWITCH_THRESHOLD_CENTER_BIAS 55   // number between 1 and 99
                                        // larger value makes it easier to "release" keys, but
harder to "press"
                                        // smaller value makes it easier to "press" keys, but
 harder to "release"
                                        // recommended values are between 30 and 70
                                        // 50 is "middle" 2.5 volt center
                                        // default value is 55
                                        // 100 = 5V (never use this high)
                                        // 0 = 0 V (never use this low


//////////////////////////
// MOUSE MOTION /////////
//////////////////////////
#define MOUSE_MOTION_UPDATE_INTERVAL  35   // how many loops to wait between
                                        // sending mouse motion updates

#define PIXELS_PER_MOUSE_STEP         4     // a larger number will make the mouse
                                        // move faster

#define MOUSE_RAMP_SCALE              150  // Scaling factor for mouse movement ramping
                                        // Lower = more sensitive mouse movement
                                        // Higher = slower ramping of speed
                                        // 0 = Ramping off

#define MOUSE_MAX_PIXELS              10   // Max pixels per step for mouse movement

/*

//////////////////////////
// ADDITIONAL KEY CODES ///
//////////////////////////

- you can use these codes in the keyCodes array above
- to get modifier keys, function keys, etc

KEY_LEFT_CTRL
KEY_LEFT_SHIFT
KEY_LEFT_ALT
KEY_LEFT_GUI
KEY_RIGHT_CTRL
KEY_RIGHT_SHIFT
KEY_RIGHT_ALT
KEY_RIGHT_GUI

KEY_BACKSPACE
KEY_TAB
KEY_RETURN
KEY_ESC
KEY_INSERT
```

```
KEY_DELETE
KEY_PAGE_UP
KEY_PAGE_DOWN
KEY_HOME
KEY_END
KEY_CAPS_LOCK

KEY_F1
KEY_F2
KEY_F3
KEY_F4
KEY_F5
KEY_F6
KEY_F7
KEY_F8
KEY_F9
KEY_F10
KEY_F11
KEY_F12

*/
```

The first variable definition, **`keyCodes[NUM_INPUTS]`** , is an array of 18 values. Each value in this array represents a single key or mouse input. Each variable in that array has a defined position, called an index, numbered from 0 to 17. KEY_UP_ARROW is at position 0, while, down at the bottom, MOUSE_RIGHT is at position 17. The positions in the array map to the MaKey MaKey inputs as such:

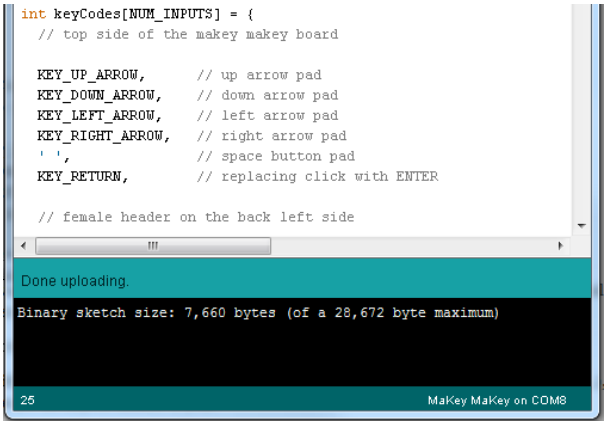


If you want to define an input as a-z, A-Z, 0-9, or other printable characters, you can fill the `keyCodes` array with single characters surrounded by apostrophes (e.g. 'a','s','d',...). If there's no printable character for the key you need, like the arrow keys, modifier keys, etc. you'll need to use one of the defined special key values. The special keys available are all printed (in comments) at the bottom of settings.h (KEY_LEFT_CTRL, KEY_LEFT_SHIFT, etc.). Their function should be pretty self-explanatory.

Just remember, there can only be **18 total values**, comma-seperated, in that array!

As an example, say you want the 'CLICK' key on the top side to instead be the ENTER key. Easy! Just go to the sixth entry (position 5, darn that 0!) in the `keyCodes` array and **replace `MOUSE_LEFT` with `KEY_RETURN`** (just like that, all caps, don't remove the comma that was there already).

To load your new code onto the MaKey MaKey, all you need to do is hit the **Upload** button (the right-facing arrow icon up top). If all of the settings in the Tools menu are correct, you should see some blinky lights on the MaKey MaKey, followed by something like this:



Now you should have some ENTER action on your MaKey MaKey, in place of the top-side click!

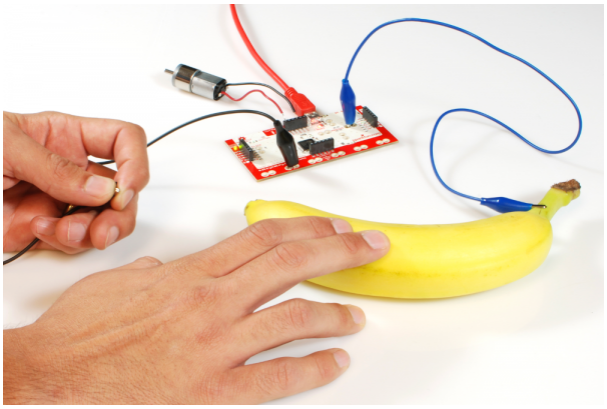
Using the Output Header

If an elephant remains in this room, it's probably that output/expansion header at the top of the board. This header is what really makes the MaKey MaKey versatile. Not only can the MaKey MaKey receive inputs from all sorts of crazy objects, but output signals back into the world.

D14 and D16 are what we're going to focus on here. The default MaKey MaKey firmware configures each of those pins as outputs. They'll produce either 5V or 0V, on depending what MaKey MaKey keys are pressed.

D14 is tied to the keyboard inputs, so whenever a keyboard button is pressed, it'll generate a HIGH (5V) voltage, otherwise it stays LOW (0V). Same goes for **D16, which is tied to mouse** buttons/movements.

What use is that? Well it's a great way to trigger external objects. You could hook up an LED to those pins, and get even more blinkies! Or, you could connect a DC motor, to automate something. Or you hook it up to a 5V relay, and really get your MaKey MaKey interacting with the world.



Anything that can operate on a 5V DC signal could be triggered by one of these inputs.

Resources and Going Further

If this is your first foray into programming in general, or even just Arduino programming, we'd encourage you to check out these resources and tutorials:

- Arduino Learning Database -- A series of code examples which will help you figure out exactly what's going on with all this Arduino code. Don't be afraid to try loading the MaKey MaKey with Arduino sketches that have little to do with MaKey MaKey-ing. A great way to learn how to code is by following code examples, of which Arduino has many. Either peer into the **File > Examples** menu within Arduino, or check out all of the links on this database.
- Arduino Language Reference -- Here you'll find links explaining the purpose and operation of Arduino's standard structures, variables, and functions. This is a great place to look up what exactly `digitalWrite()`, `int`, `loop()`, and the rest are all for.
- Arduino Community Forum -- Anything left unanswered after browsing the previous two links? Head over to the community forum! Try searching out for previously asked questions, or pose one of your own.
- Turn Your Arduino Into A Keyboard/Mouse -- How to take advantage of the Keyboard and Mouse functions of the ATmega32U4. The MaKey MaKey makes use of many of the functions discussed here. If you're curious about writing your own version of the MaKey MaKey code, this might be a handy place to start. Arduino's also got an entry for the Mouse and Keyboard library on their website.
- Arduino Comparison Guide -- Learn about other Arduino-compatible boards like the Uno and Leonardo.