MUNNY Glowing Friend with Bluetooth Control!

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https://learn.adafruit.com/munny-lamp

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Overview

MUNNY DIY is a designer toy figure designed to be modified. So, instead of simply painting him to change his appearance, let’s fill him with electronics so he can glow all the colors of the rainbow at the touch of a wireless button!

We’ll use the Adafruit Prop-Maker Wing (paired with a Feather M0 Bluefruit LE board (to drive a 3W RGB LED (Communications will come from the free Adafruit Bluefruit Connect app on your iOS or Android device!

Parts

1 x Adafruit Prop-Maker
FeatherWing

1 x Adafruit Feather M0 Bluefruit LE
Bluetooth LE microcontroller of the future

1 x 3W RGB LED
Common Anode

1 x Lithium Ion Cylindrical Battery
3.7v 2200mAh

1 x SPDT Toggle Switch
Mini Panel Mount

1 x Premium Male/Female Raw Jumper Wires
<table>
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<tr>
<td>1 x Panel Mount Extension USB Cable Micro B Male to Micro B Female</td>
<td><a href="https://www.adafruit.com/product/3145">https://www.adafruit.com/product/3145</a></td>
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<td>1 x 5V 2.5A Switching Power Supply with 20AWG MicroUSB Cable</td>
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<tr>
<td>1 x Short Feather Male Headers 12-pin and 16-pin set</td>
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**Materials**

You’ll need to get a plain white urban vinyl toy, such as our good friend [MUNNY from Kid Robot](https://www.kidrobot.com/). For this guide I used the 7” version. You could use the smaller 4” version, but you would need to leave some of the parts outside the guy!
A quick search for the term blank vinyl figure yields all sorts of fun figures that would look great filled with colored light!

Tools

The only tool required to operate on your vinyl figure is a hobby knife. Optionally, a heat gun or hair dryer will allow you to soften the vinyl and make it much easier to cut.

For the circuit, you'll need a soldering iron and solder, wire cutters, and wire strippers.
Build the Circuit

This diagram shows how the circuit will be laid out. The RGB LED and on/off switch will be connected to the Prop-Maker Wing using header pins and shrouded ("DuPont") connectors. We'll have the Prop-Maker Wing plugged into the Feather M0 Bluefruit, and the battery plugged into the Feather.

Feather Headers

To keep a low profile when fitting the electronics into our MUNNY figure, we'll use low-profile headers to connect the Prop-Maker Wing to the Feather M0 Bluefruit board.

Start by soldering the female headers to the Feather and the male headers to the Prop-Maker Wing as shown below.
3W LED Wiring

We'll use a set of four jumper wires to connect the LED to the board. The Prop-Maker Wing has a common anode RGB LED driver (triple MOSFET action!) and four breakout pads. We'll connect right-angle header pins to the board, and use a single-row wire housing on female jumper wires to make the connect to the LED.

Start by connecting the four wires as shown into the housing. I'm using:

- yellow for + voltage
- orange for R
• green for G
• blue for B

The wire crimp connectors click satisfyingly into place! Note how the yellow wire is routed to the far left.

Trim, strip, and tin the other end of the wires as shown in preparation for soldering to the LED.
Next, tin the four pads on the LED and then solder the wires to the corresponding pads.
LED Headers

Snap off a 4-pin section of right-angled header pins. To get a good placement, insert them into the LED cable housing, fit them onto the Prop-Maker Wing, and tape it in place.
Flip the board over and solder the four pins in place.
On / Off Switch Header

We'll use this same technique to make a low profile connection for the On / Off switch to the En(able) and GND pins on the Prop-Maker Wing. We'll connect these to the underside of the board.
Button Wiring

The toggle switch is a SPDT (single pole, dual throw) which means we can connect one wire to the center terminal and the other to either outside terminal. Cut, strip, and tin the two wires, then add some heat shrink tubing (optional), and solder the wires to the switch as shown.
Plug and Play

You can now plug in the LED cable and on/off switch to the Prop-Maker Wing, and then fit it onto the Feather M0 Bluefruit board.
Next, let's program the Feather!

Code in Arduino

Here we'll code the board in Arduino to change colors using the Bluefruit app on iOS ( ) and Android (), as well as to react to tilting your MUNNY to change to a random color.

There's a lot of info to digest on the Feather M0 Bluefruit LE, so check out the guide here () if you have questions.

First, get set up with Arduino IDE as detailed here ().

Next, follow these instructions () on getting the proper libraries installed. In this code we use the following libraries:

- Adafruit_BLE
- Adafruit_Bluefruit_SPI
- Adafruit_BluefruitLE_UART
- Adafruit_LIS3DH

The first three come from installing the Adafruit BluefruitLE nRF51 library.
The other library to install is Adafruit LIS3DH, which is for the accelerometer built onto the Prop-Maker Wing.

Once you've updated the board definitions as shown, you'll be able to select Adafruit Feather M0 as your board for compiling and uploading.

Before you continue, make sure you can plug in your Feather over USB and upload the Blink sketch found in Arduino IDE menu Examples > 01.Basics > Blink

If everything is set up properly, the Feather should now be blinking the onboard LED every second.

Once that's working, try running the Bluefruit example sketch, as detailed here. ()

**MUNNY Code**

Next, we'll get the Munny_Lamp.ino code to upload to the Feather. First, download the Adafruit_Learning_Systems_Guides repo here ().

You'll need to unzip the file and then navigate it to get to the Munny_Lamp directory. Move this directory it to your Arduino sketches directory.
Inside of the Arduino IDE, open the Munny_Lamp.ino sketch.

Note how Arduino automatically opens the associated BluefruitConfig.h file and the packetParser.cpp file. You won't need to worry about these, but they do need to be there for everything to function!

Upload the code to your Feather M0 Bluefruit LE now, so we can try out the remote color changing and tilt functions!

```c
// SPDX-FileCopyrightText: 2018 John Edgar Park for Adafruit Industries
// SPDX-License-Identifier: MIT

// MUNNY BLUEFRUIT LAMP
// Feather M0 Bluefruit + Prop-Maker Wing and 3W RDB LED
#include <string.h>
#include <Arduino.h>
#include <SPI.h>
#include <Adafruit_LIS3DH.h>
#include "Adafruit_BLE.h"
#include "Adafruit_BluefruitLE_SPI.h"
#include "Adafruit_BluefruitLE_UART.h"
#if SOFTWARE_SERIAL_AVAILABLE
#include <SoftwareSerial.h>
#endif

// pin definitions for using Prop-Maker FeatherWing
#define NEOPIXEL_PIN 5
#define SWITCH_PIN 9
#define POWER_PIN 10
#define RED_LED 11
#define GREEN_LED 12
#define BLUE_LED 13
int red = 0;
int green = 0;
int blue = 0;
#include "BluefruitConfig.h"
Adafruit_LIS3DH lis = Adafruit_LIS3DH();

/****************************************************************************
APPLICATION SETTINGS
****************************************************************************/

FACTORYRESET_ENABLE // Perform a factory reset when running this sketch
Enabling this will put your Bluefruit LE module in a 'known good' state and clear any config
```

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data set in previous sketches or projects, so running this at least once is a good idea.

When deploying your project, however, you will want to disable factory reset by setting this value to 0. If you are making changes to your Bluefruit LE device via AT commands, and those changes aren't persisting across resets, this is the reason why. Factory reset will erase the non-volatile memory where config data is stored, setting it back to factory default values.

Some sketches that require you to bond to a central device (HID mouse, keyboard, etc.) won't work at all with this feature enabled since the factory reset will clear all of the bonding data stored on the chip, meaning the central device won't be able to reconnect. Which pin on the Arduino is connected to the

```
PIN                       Which pin on the Arduino is connected to the NeoPixels?
NUMPIXELS                 How many NeoPixels are attached to the Arduino?
-------------------------------* /
#define FACTORYRESET_ENABLE     0
/*/
Serial.begin(115200);
Serial.println(F("Adafruit Bluefruit MUNNY LED Color Picker"));
Serial.println(F("--------------------------------"));

/* Initialise the module */
Serial.print(F("Initialising the Bluefruit LE module: "));
if ( !ble.begin(VERBOSE_MODE) )
{
  error(F("Couldn't find Bluefruit, make sure it's in CoMmanD mode & check wiring?
"));
}
Serial.println(F("OK!
");
if ( FACTORYRESET_ENABLE )
{
  /* Perform a factory reset to make sure everything is in a known state */
  Serial.println(F("Performing a factory reset: "));
  if ( ! ble.factoryReset() )
  {
    error(F("Couldn't factory reset"));
  }
}

/* Disable command echo from Bluefruit */
ble.echo(false);
Serial.println("Requesting Bluefruit info:");
/* Print Bluefruit information */
ble.info();
Serial.println(F("Please use Adafruit Bluefruit LE app to connect in Controller mode");
Serial.println(F("Then activate/use the sensors, color picker, game controller, etc!"));
Serial.println();
ble.verbose(false); // debug info is a little annoying after this point!

/* Wait for connection */
while ( ! ble.isConnected() )
{
  delay(500);
}
Serial.println(F("***********************");
// Set Bluefruit to DATA mode
Serial.println(F("Switching to DATA mode!");
ble.setMode(BLUEFRUIT_MODE_DATA);
Serial.println(F("***********************");

/****************************************************************************
@brief Constantly poll for new command or response data
****************************************************************************/
void loop(void)
{
  digitalWrite(POWER_PIN, HIGH);
  /* Wait for new data to arrive */
  uint8_t len = readPacket(&ble, BLE_READPACKET_TIMEOUT);
  if (len == 0) {
    accelerometer_check();
    return;
    delay(10);
/* Got a packet! */
// printHex(packetbuffer, len);

// Color
if (packetbuffer[1] == 'C') {
    uint8_t red = packetbuffer[2];
    uint8_t green = packetbuffer[3];
    uint8_t blue = packetbuffer[4];
    Serial.print ("RGB ");
    if (red < 0x10) Serial.print("0");
    Serial.print(red, HEX);
    if (green < 0x10) Serial.print("0");
    Serial.print(green, HEX);
    if (blue < 0x10) Serial.print("0");
    Serial.println(blue, HEX);

    analogWrite(RED_LED, red);
    analogWrite(GREEN_LED, green);
    analogWrite(BLUE_LED, blue);
}

void accelerometer_check() {
    // Accelerometer
    sensors_event_t event;
    lis.getEvent(&event);
    Serial.print("X: "); Serial.print(event.acceleration.x);
    Serial.print(" Y: "); Serial.print(event.acceleration.y);
    Serial.print(" Z: "); Serial.print(event.acceleration.z);
    Serial.println(" m/s^2 ");

    if (event.acceleration.y < 0) {
        analogWrite(RED_LED, random(0, 255));
        analogWrite(GREEN_LED, random(0, 255));
        analogWrite(BLUE_LED, random(0, 255));
        Serial.println("TILTED");
        delay(100);
    }
}

Testing

The LED will light up blue upon startup. The Feather is now waiting for you to connect to it with the Bluefruit app.
Connect

Launch the app and after a moment you'll see a list of BLE devices to which you can connect. Click the 'Connect' button next to the Adafruit Bluefruit LE device.

Controller

Now that you're connected, you can click on the 'Controller' module.
Color Picker

There are a number of choices in the Controller module, we'll use the 'Color Picker'.

Color Wheel

Now, you can pick on any color in the color wheel! Press 'Send selected color' when you want to change the RGB LED color wirelessly through the air!!
Note, you can also adjust the brightness by using the slider just below the color wheel.

**Code with CircuitPython**

You can also code your glowing friend with CircuitPython!

*CircuitPython* () is designed to simplify experimentation and education on low-cost microcontrollers. It makes it easier than ever to get prototyping by requiring no
upfront desktop software downloads. Simply copy and edit files on the CircuitPython drive to iterate.

Are you new to using CircuitPython? No worries, there is a full getting started guide here.

Adafruit suggests using the Mu editor to edit your code and have an interactive REPL in CircuitPython. You can learn about Mu and its installation in this tutorial.

Follow this guide for instructions on installing the latest release version of CircuitPython for the Feather M0 Adalogger.

Yes, even though we're using the Feather M0 Bluefruit LE, the .uf2 file we're using is that for the Feather M0 Adalogger!

Libraries

You'll also need to add the following libraries for this project. Follow this guide on adding libraries. The ones you'll need are:

- adafruit_bus_device
- adafruit_lis3dh

Download the latest adafruit-circuitpython-bundle .zip file as linked in the guide. Then, unzip the file and drag those libraries to the lib folder on your Feather.

Code

Here is the code we'll use. Copy it and then paste in Mu. Save it to your Feather as code.py

```python
# SPDX-FileCopyrightText: 2018 John Edgar Park for Adafruit Industries
#
# SPDX-License-Identifier: MIT
#
# RGB Color Picker demo - wire up RGB LEDs and set their color
# using Adafruit Bluefruit Connect App on your phone
# runs on Feather M0 Bluefruit LE running the Feather M0 Adalogger build
# of CircuitPython with Prop-Maker Wing and 3W RGB LED

import time
import random
```
import board
import busio
import pwmio
from digitalio import DigitalInOut, Direction
from adafruit_bluefruitspi import BluefruitSPI
import adafruit_lis3dh

ADVERT_NAME = b'BlinkaNeoLamp'

# RGB LED on D11, 12, 13, we're using a Prop Maker wing
red_led = pwmio.PWMOut(board.D11, frequency=50000, duty_cycle=0)
green_led = pwmio.PWMOut(board.D12, frequency=50000, duty_cycle=0)
blue_led = pwmio.PWMOut(board.D13, frequency=50000, duty_cycle=0)

# Prop maker wing has a power pin for the LED!
power_pin = DigitalInOut(board.D10)
power_pin.direction = Direction.OUTPUT
power_pin.value = True

spi_bus = busio.SPI(board.SCK, MOSI=board.MOSI, MISO=board.MISO)
cs = DigitalInOut(board.D8)
irq = DigitalInOut(board.D7)
rst = DigitalInOut(board.D4)
bluefruit = BluefruitSPI(spi_bus, cs, irq, rst, debug=False)
i2c = busio.I2C(board.SCL, board.SDA)
lis3dh = adafruit_lis3dh.LIS3DH_I2C(i2c)

def init_bluefruit():
    # Initialize the device and perform a factory reset
    print("Initializing the Bluefruit LE SPI Friend module")
    bluefruit.init()
    bluefruit.command_check_OK(b'AT+FACTORYRESET', delay=1)
    # Print the response to 'ATI' (info request) as a string
    print(str(bluefruit.command_check_OK(b'ATI'), 'utf-8'))
    # Change advertised name
    bluefruit.command_check_OK(b'AT+GAPDEVNAME='+ADVERT_NAME)

def wait_for_connection():
    print("Waiting for a connection to Bluefruit LE Connect ...")
    # Wait for a connection ...
    dotcount = 0
    while not bluefruit.connected:
        print('.', end="")
        dotcount = (dotcount + 1) % 80
        if dotcount == 79:
            print('', end=''
        time.sleep(0.5)

    # This code will check the connection but only query the module if it has been
    # at least 'n_sec' seconds. Otherwise it 'caches' the response, to keep from
    # hogging the Bluefruit connection with constant queries
    connection_timestamp = None
    is_connected = None
    def check_connection(n_sec):
        # pylint: disable=global-statement
        global connection_timestamp, is_connected
        if (not connection_timestamp) or (time.monotonic() - connection_timestamp >
        n_sec):
            connection_timestamp = time.monotonic()
            is_connected = bluefruit.connected
            return is_connected

    # Unlike most circuitpython code, this runs in two loops
    # one outer loop manages reconnecting bluetooth if we lose connection
    # then one inner loop for doing what we want when connected!
    while True:
        # Initialize the module
        init_bluefruit()
        try:        # Wireless connections can have corrupt data or other runtime
while True:
    if check_connection(3):
        resp = bluefruit.read_packet()
        if not resp:
            continue
        print("Read packet", resp)
        if resp[0] != 'C':
            continue
        red_led.duty_cycle = int(resp[1]/255 * 65535)
        green_led.duty_cycle = int(resp[2]/255 * 65535)
        blue_led.duty_cycle = int(resp[3]/255 * 65535)
    else:
        if lis3dh.acceleration.y < -5:
            print("Tilted")
            red_led.duty_cycle = random.randint(0, 65535)
            green_led.duty_cycle = random.randint(0, 65535)
            blue_led.duty_cycle = random.randint(0, 65535)
            time.sleep(0.25)

except RuntimeError as e:
    print(e)  # Print what happened
    continue  # retry!
Mod Your MUNNY

Now we've got to stuff the electronics into MUNNY! This procedure will vary depending on the vinyl figure you have. You could mount the Feather like a cool backpack, and run the LED inside the body, for example. Or you can try to get everything inside as shown here. One member of our community even suggested using a reed switch and magnet to enable hidden interface options!

These are the mods I did:

- Remove the head
- Heat the neck with a heatgun, then slice the center open with a hobby knife
- Repeat for the neck socket in the head
- Head and cut open a square in the left leg to insert the USB panel mount
- Heat and slice a flap opening into the right foot to insert the electronics

Please be careful with sharp or hot instruments.
Insert Electronics

It's a bit like building a ship in a bottle, but now you will insert the battery into the head, the panel mount through the leg, and connect and feed in the Feather and LED assembly! The video slide show will give you a good idea how to proceed.

Before putting the head back on, it's a good idea to test that everything is working!
Action

Now you can feed the USB cable and battery into MUNNY's head and close it up. I decided to have him hold onto his own on/off switch.

Turn on the switch, and then connect to the Feather using the Adafruit Bluefruit app. You can change his colors any time you like!
Tilt Action

MUNNY also has a secret mode! You can tip him upside down to randomize his color!!

This uses the accelerometer built right onto the Prop-Maker Wing to detect tilt, and it then picks random color values every half second.

Tip him back upright to stop the madness.
Recharge

You can bring your little glowing friend with you and use the battery for power. When it's time to recharge, simply plug in the USB power supply into his heel port!