BIONIC BALLERINA

OPERATIONS & MAINTENANCE MANUAL

Version *<1.0>*

Date *<10/21/2016>*

VERSION HISTORY

[Provide information on how the development and distribution of the Operations & Maintenance Manual was controlled and tracked. Use the table below to provide the version number, the author implementing the version, the date of the version, the name of the person approving the version, the date that particular version was approved, and a brief description of the reason for creating the revised version.]

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	*<Author name>*	*<mm/dd/yy>*	*<name>*	*<mm/dd/yy>*	*<reason>*

TABLE OF CONTENTS

1 INTRODUCTION

1.1 PURPOSE

The Bionic Ballerina project is comprised of a few different hardware and software developments that allow you to sequence DotStar LED effects together on a computer, simulate the choreographed effects on-screen, load effects onto a microcontroller, and synchronize music with the performance of lighting effects on the DotStar LED strips connected to the microcontroller via a signal from the computer which travels over WiFi to microcontroller using HTTP. A Lithium Ion Polymer battery is used and attached to a DC to DC converter and Protection Circuit Module (PCM) to provide power to the microcontroller and LEDs while also protecting circuits from over current, under current, and over-discharge of the battery.

1.2 AUDIENCE

Personnel who plan to install, setup, maintain, or modify the Bionic Ballerina project should read this document. If you simply plan to use the system, please refer to the user manual.

2 SYSTEM DESCRIPTION

2.1 KEY FEATURES

- *Simulate and generate sequenced lighting effects for DotStar LEDs on a computer*
- *Store lighting effect projects into a database*
- *Load lighting effects onto Pro Trinket microcontroller*
- *Play lighting sequence performance on DotStar LEDs while synchronized with music via computer, WiFi Access Point, and ESP8266 WiFi module*
- *Hardware on performer is powered by a Lithium Ion Polymer battery which is protected by PCMs from over-current, under-current, and over-discharge*

2.2 INVENTORY

Laptop/Computer with wireless network card/

DotStar Effects Composer

MariaDB Database

Arduino Desktop App

WiFi Access Point (802.11n recommended)

ESP8266 WiFi Module (3.3V)

ESP8266 WiFi Module HTTP software

Pro Trinket microcontroller (5V)

Pro Trinket WiFi Module Communication and Lighting Sequence Handler software

DotStar LEDs

Lithium Ion Polymer Battery

Battery Balance Charger

DC ? Volt to 5V DC Converter (UBEC)

Protection Circuit Module (also found with UBEC)

Logic Level Converter (Bi-directional 3.3V to 5V)

2.3 SYSTEM OPERATIONS

The user generates sequenced lighting effects in the DotStar Effects Composer software. A project is created and the effects are saved to the project as the user sequences lighting effects together. Once finished, the sequenced lighting effects are exported to a txt file. The information from the txt file is copied into the Arduino Desktop App in designated locations, then the program, along with effects, are compiled onto Pro Trinket microcontroller. After the Pro Trinket is connected to the battery and ESP8266 WiFi module, the performance can be ran, and synchronized with music, by loading music and pressing play, stop, or pause in the DotStar Effects Composer.

2.4 SYSTEM ARCHITECTURE

5 Software programs

- *DotStar Effects Composer - Create Lighting Sequences, simulates them on-screen, saves them in a project, exports code to upload into Pro Trinket microcontroller, synchronizing Pro Trinket microcontroller with music*
- *ESP8266 WiFi Module HTTP Handler - Handles the receiving of HTTP requests from Laptop/Computer DotStar Effects Composer via WiFi Access Point and passes commands to Pro Trinket microcontroller via serial interface, and also receives information from Pro Trinket microcontroller via serial interface and sends HTTP request to DotStar Effects Composer on laptop/computer via WiFi Access Point*
- *Pro Trinket WiFi Module Communication and Lighting Sequence Handler - Handles the receiving of requests from DotStar Effects Composer via serial interface and WiFi module and sends responses to DotStar Effects Composer via serial interface and WiFi module. Also runs loaded lighting sequences when requested which show on attached DotStar leds*
- *MariaDB Database – Stores projects from the DotStar Effects Composer that can be recalled and simulated*
- *Arduino Desktop App – Loads lighting sequences generated from DotStar Effects Composer onto Pro Trinket*

10 hardware devices

- *Laptop/Computer with wireless network card/adapter - communicates with Pro Trinket microcontroller via WiFi Access Point and ESP8266 WiFi Module*
- *WiFi Access Point - acts as a passthrough so Laptop/computer can communicate with ESP8266 WiFi Module*
- *ESP8266 WiFi Module (3.3V) - communicates with laptop/computer via WiFi Access Point and Pro Trinket microcontroller via serial interface*
- *Pro Trinket microcontroller (5V) - communicates with Laptop/computer via serial interface to ESP8266 WiFi Module, and to DotStar LED via pins. Also gets power from LiPo Battery*
- *DotStar LED - shows lighting effects according to signals sent from Pro Trinket. Also gets power from LiPo Battery*
- *Lithium Ion Polymer Battery*
- *Battery Balance Charger*
- *DC ? Volt to 5V DC Converter (UBEC) - connects to battery and converts the voltage to 5Vs*
- *Protection Circuit Module (also found with UBEC) - connects to battery and prevents the battery from over-discharging and over-current*
- *Logic Level Converter (Bi-directional 3.3V to 5V)- Converts 5V signals to 3.3V signals and vice versa. Protects the electrical flow between Pro Trinket and ESP8266 WiFi Module to allow communication and power to flow between each without damaging the ESP8266.*

3 PRODUCT INSTALLATION

3.1 PREREQUISITES

OS Related

Windows 7 or above operating system

.Net Framework 4.5 or above

Hardware Related

Laptop (preferred) or Desktop computer with WiFi Adapter

? Hard drive space

? Memory space

WiFi Access Point (802.11n standard preferred)

Pro Trinket microcontroller

DotStar LEDs

ESP8266 WiFi Module (ESP01 used in project, but other models should work – not tested)

Lithium Ion Polymer Battery (Amps and C rating depends on size of project)

? DC to 5V DC Converter

Protection Circuit Module (PCM) (Needed specs depends on size of project. This project uses an integrated ? DC to 5V DC Converter with PCM)

FTDI Serial Adapter Module for Arduino (3.3V and 5V capable) (Recommended: https://www.amazon.com/HiLetgo-Ft232rl-Serial-Adapter-Arduino/dp/B00IJXZQ7C/ref=sr_1_1?ie=UTF8&qid=1477148334&sr=8-1&keywords=ftdi)

3.2 ACCESS CONTROLS

User account used for installation should have administrative privileges.

User account used for using system after installation should have administrative permissions

User account used for maintaining database should have appropriate permissions setup by database administrator

3.3 INSTALLATION

MariDB MySQL

Follow this link to MariaDB downloads website - https://downloads.mariadb.org/

Download the latest stable version (this project uses 10.1.28 version, but any versions above should work as well)

Follow the steps in this link to install MariaDB - https://mariadb.com/kb/en/mariadb/installing-mariadb-msi-packages-on-windows/

Download all needed source files

Follow this link to GitHub website where needed source code is located - https://github.com/abranch307/BionicBallerina

Download entire project by clicking the 

button located near the center-right of the webpage

Click “Download Zip” and save to a temporary download location

Extract zip to directory where it can be saved and left without unwanted modifications (Program Files or My Documents are two good locations)

DotStar Effects Composer

Navigate to this directory within the unzipped folder: ..\BionicBallerina\Src\LEDLightingComposer\LEDLightingComposer\bin\Release

Double-click the "DotStarEffectsComposer" application

A shortcut can be created and placed on the desktop for easier, future access

Arduino Desktop App

Follow this link to Arduino downloads website - https://www.arduino.cc/en/Main/Software

Download the latest version's "Windows Installer"

Follow the steps in this link to install the Arduino Desktop App - https://www.arduino.cc/en/Guide/Windows

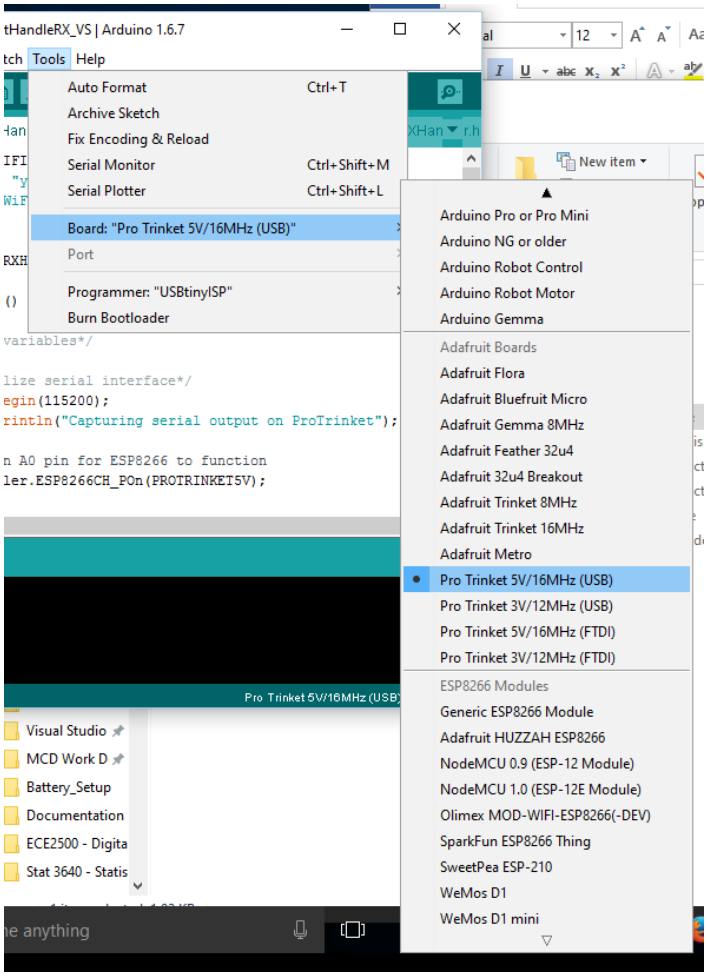
Pro Trinket Lighting Effects Handling & WiFi Module Communication (Subject to Change…)

Navigate to this directory within the unzipped folder: ..\BionicBallerina\Src\ \ProTrinketHandleRX_VS

Double-click the "ProTrinketHandleRX_VS" Arduino file

Click "Tools"

Select "Pro Trinket 5V/16MHz (USB)" for Board (see below image)



Choose "USBtinyISP" for programmer

Connect Pro Trinket to computer via micro usb cable

Click the "Reset" button on the Pro Trinket and, while the led is flashing red, press the  *button in the Arduino Desktop App screen to upload program*

Repeat for all Pro Trinkets being used in project

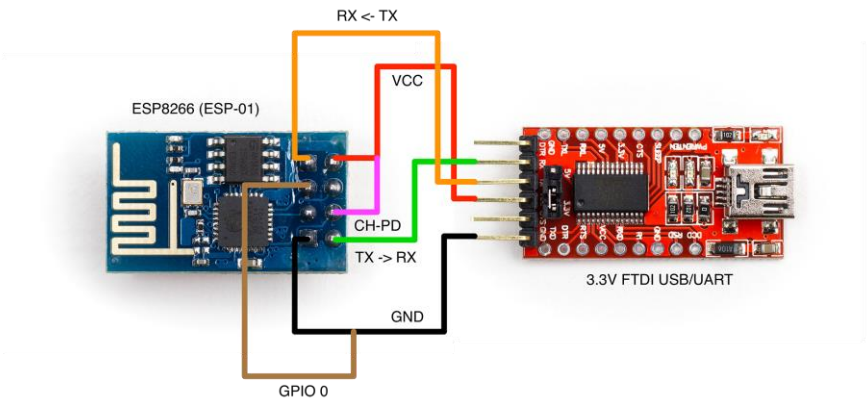
FTDI Serial Adpater Module for Arduino (Needed for ESP8266 software upload and serial communication debugging)

Connect the FTDI to computer via provided cable

Allow windows update to install necessary

ESP8266 WiFi Module HTTP Handling & Pro Trinket Communication (Subject to Change)

Connect ESP8266 WiFi module to computer via FTDI (connect as portrayed in below image)

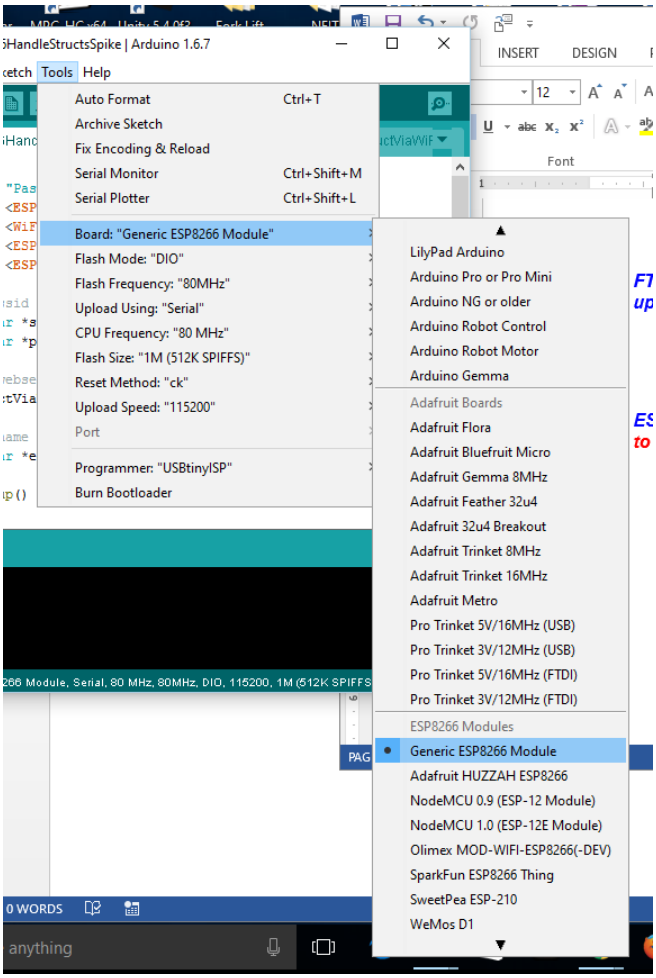


Navigate to this directory within the unzipped folder: ..\BionicBallerina\Src\ \ESP8266HandleStructsSpike

Double-click the "ESP8266HandleStructsSpike" Arduino file

Click "Tools"

Select "Generic ESP8266 Module" for Board (see below image)



Choose the "Port: COM(?)" that refers to the connected FTDI (you can disconnect FTDI then reconnect and see which port appears to ensure you're using the correct COM port)

press the  *button in the Arduino Desktop App screen to upload program*

Connect ESP8266 to Pro Trinket

Solder ESP8266's RX and VCC pins to Logic Level Converter

Solder Pro Trinket's TX and 5V pins to Logic Level Converter that corresponds to ESP8266's RX and VCC pins respectively (RX -> TX, and VCC -> 5V)

Connect ESP8266 GND pin to Pro Trinket GND pin

Connect ESP8266 TX pin to Pro Trinket RX pin

Connect ESP8266 CH_PD pin to Pro Trinket A1 pin

Repeat for all ESP8266 WiFi Modules being used in project

3.4 CONFIGURATION

MariaDB MySql Configuration (needed for DotStar Effects Composer):

Open HeidiSQL application by double-clicking icon or searching in apps menu

Click "Open" in the Session Manager window to connect to database

Login as "root" user with password setup during MariaDB installation

In the "Local DB Server" window, left-click the "test" database in the left pane

Click "File > Load SQL file…"

From extracted project zip file, navigate to "..\BionicBallerina\Database_Scripts"

Open and run each by clicking the  *button (or hitting F9 key) in this order*

LED_PROJECT.sql

LIGHTING_EFFECTS.sql

MCU.sql

MCU_PINS.sql

LED_EFFECT.sql

Load sample data into tables in this order: (Files need to be created and steps finished)

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WiFi Access Point:

Follow instructions from purchased WiFi Access Point manufacturer's user manual

Set SSID as "DOTSTARCOMPOSER"

Set encryption to WPA2 - AES

Set passphrase to "dotstar1234"

4 SYSTEM USAGE

4.1 INSTRUCTIONS

See User Manual in extracted project zip file here: (create and then place location here)

4.2 CONVENTIONS AND ERROR MESSAGES

DotStar Effects Composer:

A message box will appear, explaining the error if an error occurs

5 SYSTEM MANAGEMENT

5.1 SECURITY ADMINISTRATION

Install WiFi Access Point updates as they become available

Prevents unwanted users from gaining access to network

Install Windows Updates as they become available

Prevents unwanted users from gaining access to computer

5.2 SYSTEM ADMINISTRATION

Install .Net Framework Updates as they become available

Install MariaDB MySql updates as they become available

Re-charge Lithium Ion Polymer battery with balancer as needed

Monitor battery discharge with battery checker

6 SYSTEM MAINTENANCE

No system maintenance will be provided. Any changes to the program will be done by the user of this open source project

7 DATABASE ADMINISTRATION AND MAINTENANCE

The MariaDB MySql database should be kept up-to-date with updates from vendor

8 ROLES AND RESPONSIBILITIES

User

Developer

Database Administrator

9 FAQS

None yet

Appendix A: Operations & Maintenance Manual Approval

The undersigned acknowledge they have reviewed the *<Project Name>* **Operations & Maintenance Manual** and agree with the approach it presents. Changes to this **Operations & Maintenance Manual** will be coordinated with and approved by the undersigned or their designated representatives.

[List the individuals whose signatures are desired. Examples of such individuals are Business Steward, Implementation Manager or Project Sponsor. Add additional lines for signature as necessary. Although signatures are desired, they are not always required to move forward with the practices outlined within this document.]

Signature: _____ Date: _____

Print Name: _____

Title: _____

Role: _____

Signature: _____ Date: _____

Print Name: _____

Title: _____

Role: _____

Signature: _____ Date: _____

Print Name: _____

Title: _____

Role: _____

APPENDIX B: REFERENCES

[Insert the name, version number, description, and physical location of any documents referenced in this document. Add rows to the table as necessary.]

The following table summarizes the documents referenced in this document.

Document Name and Version	Description	Location
<Document Name and Version Number>	*[Provide description of the document]*	*<URL or Network path where document is located>*

APPENDIX C: KEY TERMS

[Insert terms and definitions used in this document. Add rows to the table as necessary. Follow the link below to for definitions of project management terms and acronyms used in this and other documents.

The following table provides definitions for terms relevant to this document.

Term	Definition
[Insert Term]	*[Provide definition of the term used in this document.]*
[Insert Term]	*[Provide definition of the term used in this document.]*
[Insert Term]	*[Provide definition of the term used in this document.]*