Introduction

This document gives the background needed to build the “Magnetic Dance Glove” (MDG). The MDG is a wearable controller that is used by a dancer or other kind of performer to send movements of the hand that it is worn on wirelessly to a computer that participates as a node in the Magnetic Dance project. The last section of the document discusses 3 yet unsolved problems, and possible solution measures. There is enough information to solve the problems, but the main concern is keeping the required effort within the time resources available to each partner. Approximate timeline for getting the solutions is Friday 8 to Monday 11 of June.

System Description

Hardware

Wearable sensor module (MDG)

The MDG consists of a sensor measuring velocity and acceleration in 3 dimensions (BMO055, here: “the sensor”), connected to a wireless transmitter (ESP8266, here: “the transmitter”) via a two-wire interface (TWI, I2C protocol), and powered by an ion-polymer battery. The MDG hardware should be attached on a sleeve provided with a hole for passing the thumb to hold the sleeve’s upper part (where the sensor is) on the lower back of the hand of the performer (Such sleeves are available on Amazon as UV Protection Arm Sleeves). Model specifications and links for online shopping are provided below in the Component section.

Programming and Sound production Workstation (“workstation”)

A workstation equipped with at least i5 performance comparable CPU, 4 GB RAM, stereo sound output, and running Linux or MacOS is required to run the software which processes and transmits the data.

Software

The following two components are necessary.

1. SuperCollider V3.9.x (Live performance)
2. Micropython (Programming or uploading the program to the MDG)

Documentation and code is distributed to the locations via github at: https://github.com/iani/magnetic-dance.

A driver is needed to access the transmitter via USB in order to transfer micropython files. The details are described online here: https://docs.micropython.org/en/latest/esp8266/esp8266/tutorial/intro.html#intro In the magneticdance software repository, I will give a summary based on the work that I did.

Data

The transmitter polls the data of the sensor at ca 50 Hz and sends each sample as a data vector of 9 floats in an OSC message with the command “/data/<cityname>”, where <cityname> is the name of the city where the data are measured locally. Eg. in Manchester, at each measurement, the transmitter will send wirelessly the OSC message:

```
/data/manchester  x1 y1 z1 x2 y2 z2 x3 y3 z3
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These data are received locally by a workstation dedicated to the performance running SuperCollider. They are forwarded (broadcast) to all other locations via OSC.

Components

1. Sensor: Adafruit BMO055 https://www.mouser.be/ProductDetail/Adafruit/2472?qs=sGAEpiMZZMsMyYRRhGMFNuFoI0IaQxst8qeHhFTzrMI%3d
2. Transmitter: Adafruit Feather Huzzah ESP8266 https://www.mouser.be/ProductDetail/Adafruit/2821?qs=sGAEpiMZZMvt1VFuCspEMmzMiIwIRI0s43xeMM77VeM%3d
   The transmitter has a micro USB plug for connecting to the computer and a battery plug for connecting to power sources for autonomous use. One must get a battery with a fitting plug type for the transmitter (see problem discussion below).
3. Connectors: Made from Sparkfun Conductive Thread Bobbin - 12m (Smooth, Stainless Steel or similar types of conductive thread. https://gr.mouser.com/ProductDetail/SparkFun/DEV-10867?qs=sGAEpiMZZMuM1nRwI3zz2UpCr55iWBr5%2bbxbh49Hgbsg24TQhA%2bt2w== There is a hairy version (https://grobotronics.com/conductive-thread-bobbin-30ft-stainless-steel.html) and a smooth version (https://www.digikey.be/product-detail/en/sparkfun-electronics/DEV-13814/1568-1804-ND/5993841). I have the hairy version but the smooth one might be better.
   1. NOTE: Some parts of the thread at least must be wrapped in thin insulating cover to prevent shorts.
4. Rechargeable Lithium Ion Polymer Battery, 3.7 Volts, minimum 500mAh, provided with connector for plugging into the Transmitter as in: http://www.oddwires.com/li-ion-lipo-lithium-ion-polymer-battery-3-7v-500mah-lp503035/ The attachment to the transmitter is shown in https://learn.adafruit.com/adabox001/lithium-polymer-battery (See also problems section at the end.)
5. (Black) Glove/arm cover: UV Protection Fingerless arm sleeve with Thumb hole, eg:
   1. https://www.amazon.com/Sleeves-Cooling-Protection-Outdoor-Gardening/dp/B073SNDVGT
   2. https://www.amazon.com/Sleeves-BoChang-Protection-Protective-Activities/dp/B075B76MMS/ref=pd_lpo_vtph_468_tr_t_2?_encoding=UTF8&psc=1&refRID=9M83WN64ZW8GAXCM1Y8Y
   3. https://www.amazon.com/SHINYMOD-Protection-Sunblock-Protective-Basketball/dp/B071LMQD2S/ref=pd_lpo_vtph_468_bs_t_1?_encoding=UTF8&refRID=9M83WN64ZW8GAXCM1Y8Y&th=1

Wiring

Figure 1 shows how the wiring looks in the currently implemented prototype. Note that due to the arrangement of the holes in different order (BNO: SDA-SCL, ESP: SCL-SDA), the SCL and SDA wires have to cross. We need to discuss how to ensure that they will never touch each other. Weaving them onto the fabric of the glove will not work because of the crossing. Thus, at least one of the 2 threads will need to have an insulating coat at least at the part where the crossing takes place. Legend

"HIGH and "LOW" refer to the rows on the devices placed with their names written
in upright orientation as depicted here.
The IO holes are numbered from left to right.

ESP = Adafruit Huzzah ESP8266
BMO = Adafruit BMX055

Power connections:

Wire 1: From ESP 3V (LOW 2) to BMO Vin (LOW 1)
Wire 2: From ESP GND (LOW 4) to BMO GND (LOW 3)

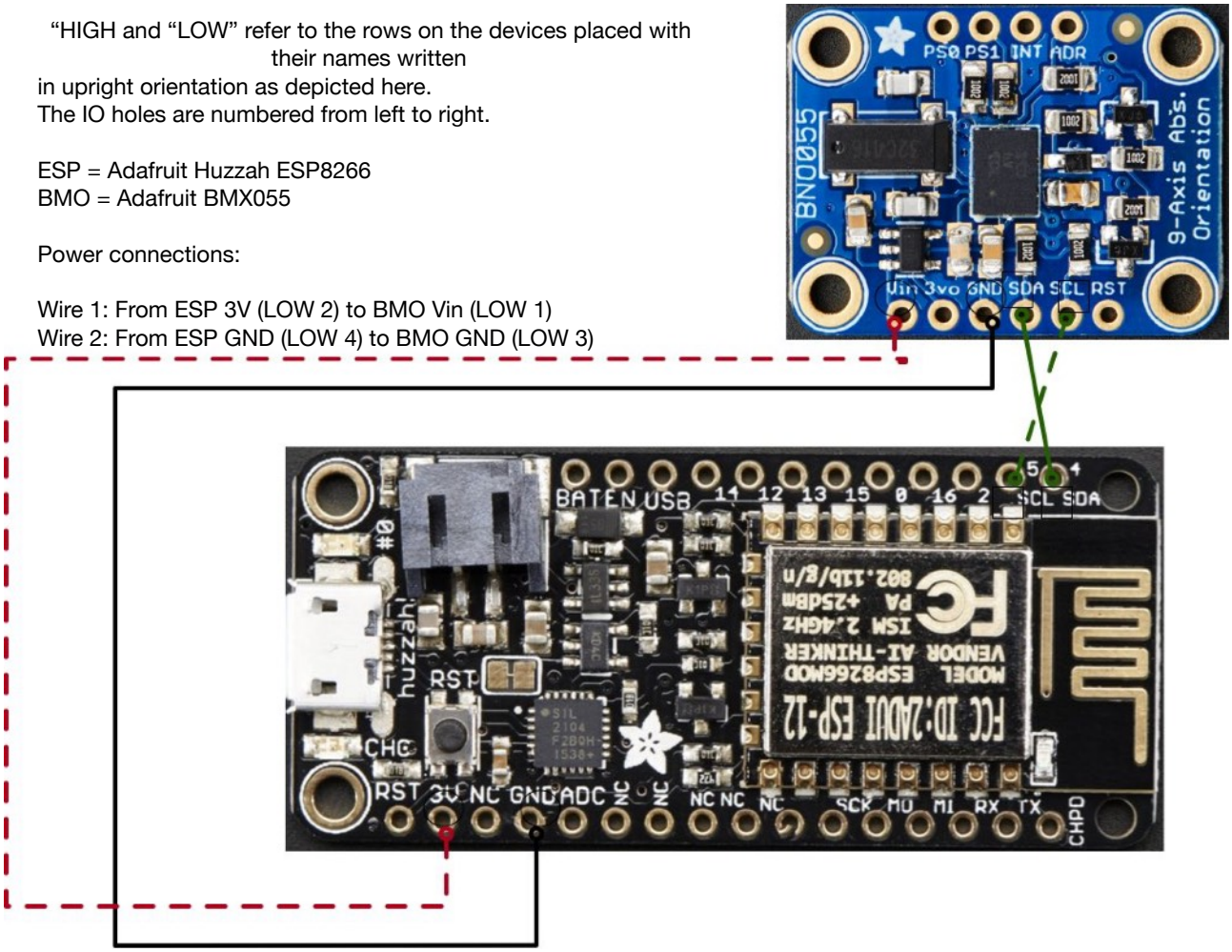

FIGURE 1: PINOUT (WIRING) DIAGRAM

Figure 2 shows the assembled prototype, using common breadboard-use wires plugged to headers soldered onto the holes of the two boards. The NCL and SDA wires (yellow and orange) have to cross because of the different order of the holes.

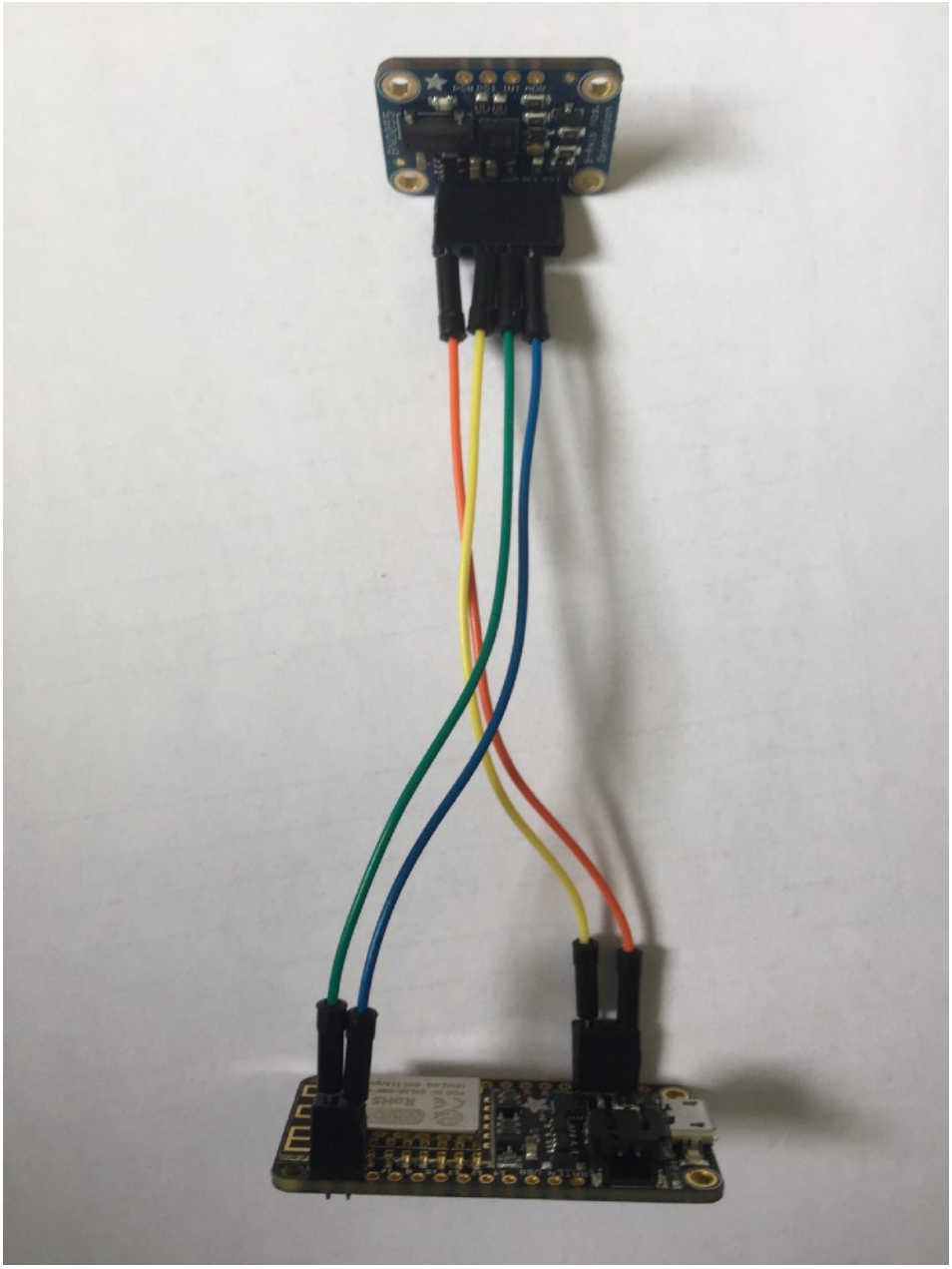

FIGURE 2: CONNECTED PROTOTYPE WITH CROSSING WIRES

Connection of battery to transmitter, charging the battery

The battery is plugged onto the transmitter, and the transmitter charges the battery automatically as soon as it is connected to an electric source via the micro USB plug. A battery with a fitting plug must be provided (see Problems section). Figure 3 shows the current mismatching plugs on battery and transmitter.

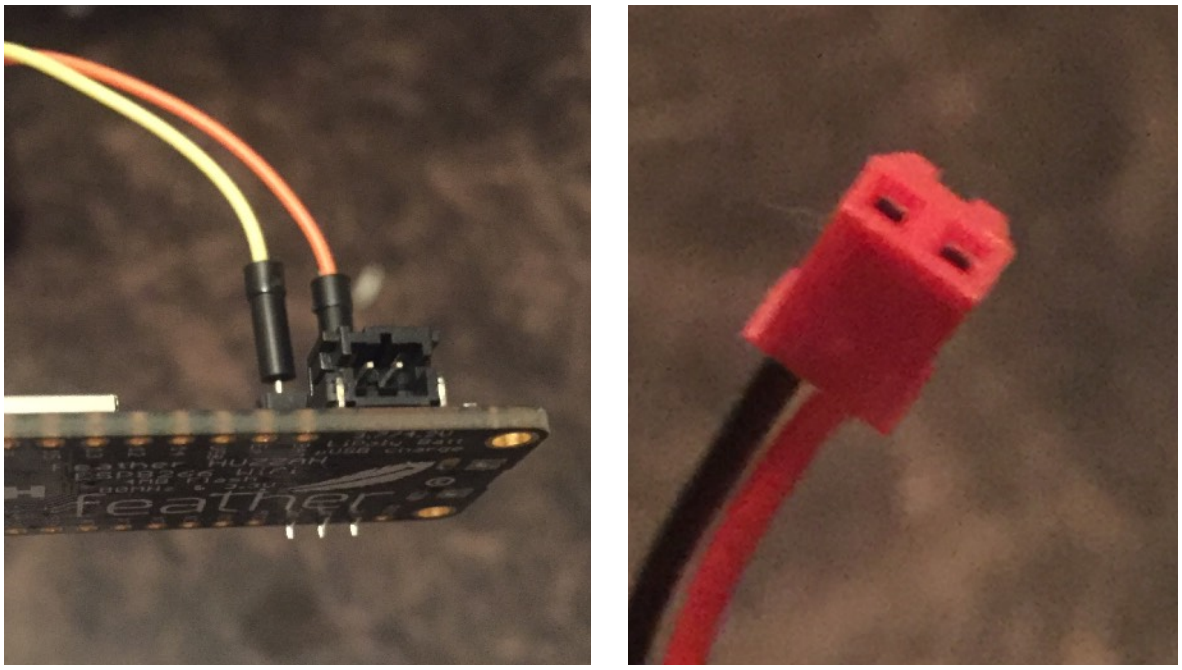

FIGURE 3: TRANSMITTER AND BATTERY MISMATCHING PLUG

Attachment of sensor and transmitter to glove

Figure 3 shows the position of the sensor the glove on the glove. The sensor is provisionally attached with rubber bands. The final solution requires 2 elastic fabric strips wrapped around the glove or 2 pockets sewn onto it, to insert the sensor and transmitter securely (see Problems section).

FIGURE 3: ATTACHMENT POSITION OF SENSOR ON GLOVE

Problems

1. The plug of the battery I bough in Athens does not fit into the battery connector of the transmitter. The correct plugging in to the transmitter is shown in https://learn.adafruit.com/adabox001/lithium-polymer-battery, and the battery shown there is http://www.oddwires.com/li-ion-lipo-lithium-ion-polymer-battery-3-7v-500mah-lp503035/ I need to look urgently for appropriate battery here.
2. How to wire the device with thread so that both sensor and transmitter are free to be attached onto the glove. There are 2 questions:
    1. I have not tried attaching with thread wires yet, and do not know if just tying the thread to the holes and possibly securing with nail polish is sufficient. This youtube video from Adafruit shows how to attach the thread on holes by tying only: https://www.youtube.com/watch?v=qGjOoSYfbkM (See second 7). Details with photos are found here: https://learn.adafruit.com/conductive-thread/connecting-components
    I have just received the 2 new sets of sensors/transmitters and am going to test the connections by threading on one of them, using improvised insulation on the threads.
    2. The best method to insulate the threads. Sparkfun lists several alternative methods on this page: https://learn.sparkfun.com/tutorials/insulation-techniques-for-e-textiles
    I need to work on this, and find a method which is feasible for all project partners building the glove.
3. Attaching the assembled sensor-transmitter-battery to the glove. I need to get some elastic straps wide enough to cover the sensor and the transmitter the straps could be sewn glued partially onto the glove to secure their position and create a simple pocket to slide the hardware parts in.

I have contacted specialists here and expect to be working on this from Wednesday 5.6. onwards. Solutions should be available between Friday 8th and Monday 11th June approximately.