REMOTE PULSE

BY RAFAEL LOZANO-HEMMER



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GENERAL IMPORTANT INFORMATION

This short section must be read for proper operation.

REMOTE PULSE, INDOOR VERSION (2019)

BY RAFAEL LOZANO-HEMMER

Technique

Corian slab, aluminum mount, , heart rate sensor plates, circuits, transducers, lightbulbs.

Description

"Remote Pulse" is an interactive installation consisting of two identical pulse-sensing stations that are interconnected over the internet. When a person places their hands on one station automatically the person on the other station feels their pulse, as the plates vibrate in sync with the heartbeat of the remote person, and vice versa. The piece was originally presented as part of Lozano-Hemmer's "Border Tuner" installation across the US-Mexico border, with one station in Ciudad Juárez, Chihuahua and the other in El Paso, Texas.

Operation

Please refer to <u>Appendix I - Installation</u> for detailed system information and wiring diagram.

Before use, make sure to connect an ethernet cable to the Raspberry Pi inside the station in order to provide it with internet.

To turn **On** a station:

- 1. Connect the station's power cord to an electrical outlet. This could be set on a schedule, using an AC timer if you like.
- 2. It will take 3 minutes before the PI is booted and the software starts.
- 3. The 2 lamps will flash on for a few seconds right after the software starts. In addition the stations should vibrate for a moment.
- 4. Now the station(s) can communicate with each other. In the case only one station is powered On or if the network/Internet connection is not established, the station(s) will run in standalone mode.

To turn **Off** a station: if the artwork isn't running on a timer, disconnect the station's power cord to an electrical outlet.

General Artwork Behaviours

- 1. When a heart rate is successfully measured on the local station, the left lamp starts flashing according to the measured BPM: the speed of flashing will change with each new BPM measurement, as long as the hands touch the plates.
- 2. When someone on the remote station places their hands on their plates the right lamp will illuminate and eventually start flashing.
- 3. At the same time you will feel the remote beat vibrating under your hands.
- 4. As soon as you release your hands the left lamp will turn off.
- 5. As soon as the remote person releases their hands the right lamp will turn off and the vibration will stop.

Interacting with the Artwork

- 1. Place both hands on plates. The left light should turn on with a constant illumination.
- 2. After a few seconds when the heart rate was successfully measured the left lamp starts flashing according to the measured BPM: the speed of flashing will change with each new BPM measurement, as long as the hands touch the plates.

Maintenance

To clean the Corian surface of fingerprints or smudges, use a mild dish soap and water, applied to a damp rag. Similar to a stone countertop, the surface can be rubbed clean of mild wear fairly easily. Please <u>contact the Studio</u> if any scratches, permanent marks, or chips or cracks occur.

Placement Instructions

The placement of each unit needs to be decided in consultation with the artist and Studio. Generally, the bottom of the artwork will be installed at 81cm (31") away from the ground, allowing adults and children to stand comfortably in front of the sculpture

Each unit is hung with a custom bracket mounted onto a supporting wall or structure. The walls need to be reinforced to accommodate approximately 50 lbs load (23 kg) per unit.



DETAILED TECHNICAL INFORMATION

Normal Software Operation

When the Raspberry Pi first starts (when power is being connected to the station) it takes about 3 minutes before the "remotePulse" software automatically starts.

If the software is shut down (esc key or by closing the app window) a watchdog script will start it again 1 minute later.

Manual Software Calibration

With an external monitor plugged into the Pi, or through remote access you will be able to access the software's calibration.

Pressing key **g** will make the GUI appear or hide it if it's already up. Upon hiding the GUI its settings get saved. The following two images show what the app looks like when it's been properly opened with the GUI visible.



Other GUI Elements Used for Setup:

This is a detailed breakdown of the software's available GUI elements. Each section has a short explanation of its function in the header and an explanation of what each field does. If a field has no explanation it should not be touched.

remotePulse	This section deals in general with debugging and settings necessary to run the app.
ver	app version number, date, git hash
lightvVaDMX	Check this if used with Enttec USB DMX light control
lightViaSerial	Check this if used with custom serial PCB light control
showGUI	like key g show/hides GUI
debug	prints more info in console
enableAutoFake	This should only be checked during debug: simulates an heartbeat detection on the local side.
debug	only use things under this section for debug
fadeTest	creates fading light control values
testDMXChain	1 of 4 light channels used for debugging
textDMXValues	manually set light value
triggerMeFake	click 2 times to set local manual BPM
meTouched	select to simulate local hands touching
meFakeBPM	manually set local BPM value
triggerOtherFake	click 2 times to set remote manual BPM
otherTouched	select to simulate remote hands touching
otherFakeBPM	manually set other BPM value
autoFake	min/max after how long of local hands touching a fake remote BPM will appear
minLocalActiveDur	min how long after local hands released will fake remote BPM disappear

maxLocalActiveDur	Max how long after local hands released will fake remote BPM disappear
minLocalInActiveDur	Min how long after local hands released will fake remote BPM disappear
maxLocalInActiveDur	Min how long after local hands released will fake remote BPM disappear
remoteInActiveDur	inactivity duration before allowing fake BPM
fakeTouchDur	duration of fake solid light for touch before flashing
heartme	Adjusts settings related to the heart of the local pulse.
dmxChan beat1	can be set to use 1 of 4 possible light channels (dmx and serial). When using lightViaSerial the 4 channels are the 4 dimming outputs on the custom PCB.
dmxChan beat2	can be set to use 1 of 4 possible light channels (dmx and serial). When using lightViaSerial the 4 channels are the 4 dimming outputs on the custom PCB.
useAudio	for debug ONLY, the local BPM can also be set to cause the transducers to actuate.
Heart other	Adjusts settings related to the heart of the remote pulse. A heart beat consists of 2 pulses, the primary/first and secondary/second beat.
dmxChan beat1	can be set to use 1 of 4 possible light channels (dmx and serial). When using lightViaSerial the 4 channels are the 4 dimming outputs on the custom PCB.
dmxChan beat2	can be set to use 1 of 4 possible light channels (dmx and serial). When using lightViaSerial the 4 channels are the 4 dimming outputs on the custom PCB.
useAudio	by default ONLY heart other has useAudio selected
minBpmCount	How many readings are needed before starting lights to flash
minBpm	Unused
firstBeatOnDur	How long the 1st beat lasts, during which the light fades from maxBright to minBright.
firstPause	How long the light is off before starting with the 2nd beat.
secondBeatOnDur	How long 2nd beat lasts, during which the light fades from secondMaxBright to secondMinBright
touchBright	Unused

firstMinBright	Unused
firstMaxBright	Unused
secondMinBright	Unused
secondMaxBright	Unused
firstVol	how loud/strong the transducer is actuated
secondVol	how loud/strong the transducer is actuated
forceUnTouch	in case releasing hands does not get detected we can force an unTouch event if after x-seconds no new BPM was measured.
serialSensor	Not used at this point do not change these values
smoothing	Unused
accumAmount	Unused
internet	The local app sends and receives data from the cloud server via an internet connection. This section relates to those settings.
enableWeb	needs to be selected for app to establish connection
webSendIntervalMil	millisecond interval to check if new message needs to be sent to server.
Other touch received	displays server values
Other bpm received	Unused
Me touch sent	Unused
Me bpm sent	Unused
periodicResend	Not used do not check
socket	Header for the Check Database section
checkDatabase	interval in seconds used for sending/requestion new cloud server data.
appStarted	Unused
Send	Unused

Network Configurations

There are two possible ways that this artwork's networking can be configured.

- 1. Wired ethernet connection that provides a connection to an internal network
- 2. Wired ethernet connection that provides a connection to the internet

The software the studio sends will be compiled differently for each of the versions mentioned above. Please ensure that you are setting up the appropriate network connection for your version of the software.

Wired ethernet connection that provides a connection to an internal network

When using a local network the piece will use OSC to allow both corian units to communicate with each other. In order to do this both stations should be assigned a fixed IP address. An example of what that might look like can be found below.

Network Preferences ✓ × Configure: ● interface ▼ ▲ eth0 ▼ Automatically configure empty options	:33
Network Preferences ✓ × Configure: Image: Ima	
Network Preferences ✓ × Configure: Image: Ima	
Network Preferences ✓ × Configure: □ interface ▲ eth0 ✓ Automatically configure empty options	
Configure: Pinterface - Automatically configure empty options	
Automatically configure empty options	
Disable IPv6	
IPv4 Address: 10.101.38.131/23	
IPv6 Address:	
Router: 10.101.38.1	
DNS Servers: 10.101.38.1	
DNS Search:	
Clear Apply Close	

Wired ethernet connection that provides a connection to the internet

When using an internet connection the piece will use MQTT to allow both stations to communicate with each other. In order to do this both stations should be set up to receive an IP from the DHCP network. An example of what that might look like can be found below.

Network Preferences 👻 🔺 🗙
Configure: Dinterface 🗸 📑 etho
Automatically configure
Disable IPv6
IPv4 Address;
IPv6 Address:
Router.
DNS Servers:
DNS Search:
Clear Apply Close

Remote Access to Artwork's Computer

There is a software installed on the computer running this artwork that allows the studio to connect remotely to the artwork. This feature is helpful when you require assistance from the studio, as we can remotely connect to it, do a quick inspection, and do a debugging session of your components, if needed. In order to enable this feature, the Raspberry Pi has to be connected to the internet at all times.

Remote Pulse has realVNC installed to allow remote access to both stations. In order to access either station remotely install VNC viewer and ask us to add you with your email to the remotePulse Team account.

Preliminary Troubleshooting Steps

Placing hands does not cause left lamp to illuminate

- 1. Check that the station is connected to power.
- 2. Check that the PCB has some LEDs illuminated to insure that it gets power.
- 3. Check that one of the PCB LEDs starts blinking rapidly when hands get placed and stops blinking rapidly when hands get removed. If not then the heart rate sensor does not see the hands.
- 4. Where each lamp's cable connects to the PCB a small LED flashes just like the big lamp should flash. If this LED is flashing but the lamp is not, then the lamp is broken, loose or the cable is loose.

The remote user is placing their hands but my local station does not illuminate.

- 1. It's possible your local left lamp is not functioning. Go through the steps in point 1.
- 2. If that doesn't fix the problem the internet connection between both stations is not working.
- 3. Check that the ethernet cable is properly attached to each Raspberry Pi and that the pi is receiving power. Lights will be on when the Pi is properly powered.
- 4. Now we need to check that the ethernet cable is properly providing internet.
- 5. If you want to access the computer manually, Open the front station panel and look at the top right of the desktop. There you will find the network and VNC icons which will indicate their connectivity status. Or use realVNC software on your own computer and try to connect remotely. A properly connected pi will have icons on the desktop that appear like those in the image below.



The transducers cause a rattle when the remote pulse is being received.

Check the images below to see how a small round metal plate is holding each transducer. They have spring loaded screws that can be tightened to stop the vibration creating this rattle noise.



Image of a Transducer

Troubleshooting Assistance

Prior to contacting the Antimodular Studio with a problem about your artwork, please ensure that you went through the preliminary troubleshooting steps outlined in the previous section.

The troubleshooting process will vary depending on the problem. In order to make the process easier, it is recommended that you collect and send the following information to the studio:

- Date and time when the problem first happened;
- Description of the problem;
- Actions taken so far and conclusions;
- Detailed photographs (or videos) displaying the problem;
- Detailed photographs (or videos) of the suspected faulty component;
- Detailed photographs (or videos) of the whole artwork and its surroundings;
- Personnel involved.

Support (Contact Us)

If you would like support for the piece, please feel free to call Lozano-Hemmer's studio in Canada:

Antimodular Research 4462 rue Saint-Denis Montréal, Québec, Canada H2J 2L1 Tel 1-514-597-0917 info@antimodular.com www.antimodular.com

APPENDIX I - INSTALLATION

Description of Components

This artwork requires the following components:

Component	Description
Raspberry PI 4	Runs the piece's software
Heat sink housing for PI4	Prevents the Pi from overheating
8GB micro SD card	Stores the code in the piece.
2 x Audio Transducer	Helps create the vibrating feeling
2 x LED bulb	LED Bulb
2 X 12v DC Converter	Provides power to the DMX Dimmer and the Audio Amplifier
5v DC Converter	Provides power to the Raspberry Pi
24V 1.7A Power supply	Provides power to the entire Corian structure. Can be quite longe up to 30 m
Polar heart rate sensor, model: 94051253	Senses participants heartbeats
custom PCB	Connect to lamps, hands and polar sensor
DMX Dimmer, model: SR-2108FB3-RJ45-DIN	Controls the intensity of the bulbs
USB-B to DMX Interface	Converts USB data to DMX compatible data
Teensy 3.2 or 4.0	Handles Audio processing
Wireless Keyboard	Optional for testing purposes only
1 x external display	Optional. For testing purposes only

Images of components, for consultation:





Raspberry PI 4, BCM2711 Model B 4GB

Heat Sink



Sd Card



Audio Amplifier





Lamp

Transducer





DMX Dimmer

Polar Heart Rate Sensor





Power Cord





•	
	(in the second

13.3" IPS LED Screen	1

Reso

Resolutions 1920*1080 800:1

Contrast 800:1

Size 12.7*8.07*0.59 in

Pi Display

Logitech Wireless Keyboard

Diagrams and Connections

The electronics and components contained inside the corian unit should never be touched or tampered with unless explicitly instructed by the Studio.

The following diagram represents the internal contents of the corian unit.

These images show the contents as they appear in real life.

Corian Unit with cover removed

Custom Circuit

Assembly Instructions

Insert the lightbulbs in each unit. These are LED bulbs designed for use in cars that will require pressing the bulb down firmly and twisting to affix the bulb.

Install the provided internet router nearby, or plug the ethernet cable into each unit, depending on the connection type determined by the Studio. Cables should be hidden, or run down the wall seamlessly, perhaps using a cable cover.

Repeat the above steps with the second station.

APPENDIX II - TECHNICAL DATA SHEETS

Raspberry Pi

The Pi must be at least a model 4

Model 4

Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.8GHz
4GB of RAM minimum. 8GB is also alright (depending on model)
2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE Gigabit Ethernet
2 USB 3.0 Port
2 USB 2.0 Port
4 Pole stereo output and composite video port
Micro SD Port
2 Micro-HDMI Ports

Transducers

Product Specifications	
Manufacturer	DAYTON AUDIO
Туре	Dual Steel Spring Balanced Exciter
Impedance	8 ohms
Power Handling (RMS)	20 W
Frequency Response	- Hz
Sensitivity	- dB

Specifications — MPA 122

Audio

Frequency response	20 Hz to 20 kHz, ±1 dB @ 1 watt output
THD + Noise	0.1% @ 1 kHz at nominal level (1 watt, 8 ohm load)
S/N	>74 dB @ 20 Hz to 20 kHz at maximum output (unweighted, with balanced input)
Stereo channel separation	>55 dB @ 1 kHz, >45 dB @ 20 kHz
CMRR	80 dB @ 1 kHz, 70 dB @ 20 kHz
Bass adjustment	±10 dB @ 80 Hz (reference) to 1 kHz (2 dB tolerance)
Treble adjustment	±10 dB @ 10 kHz (reference) to 1 kHz (2 dB tolerance)

Audio input

Number/signal type	1 stereo, balanced/unbalanced input
	2 stereo, unbalanced inputs
	(The three inputs are individually buffered and mixed together.)
Connectors	(1) 3.5 mm captive screw connector, 5 pole (main input)
	(1) 3.5 mm mini audio jack (tip, ring, sleeve)
	1 pair RCA
Impedance	>18k ohms unbalanced, >24k ohms balanced, DC coupled
Nominal level	+4 dBu (1.23 Vrms) balanced or -10 dBV (316 mVrms) unbalanced
Maximum level	
Level pot. at 10 o'clock	+6 dBV (unbalanced), +16 dBu (balanced) at 1% THD+N
Level pot. at 9 o'clock	+17 dBV (unbalanced), +27 dBu (balanced) at 1% THD+N
Input level sensitivity	-18 dBV from unbalanced input for maximum output (11 watts with a 4 ohm load and level set to maximum) before clipping

NOTE $0 \, dBu = 0.775 \, Vrms, \, 0 \, dBV = 1 \, Vrms, \, 0 \, dBV \approx 2 \, dBu$

Audio output

Number/signal type	1 stereo or 2 mono (2 channels total)
Connectors	(1) 5 mm captive screw connector, 4 pole
Minimum load impedance	4 ohms
Amplifier type	Improved Class D
Continuous power with a full los	ad and 1% THD
At 4 ohms	11 watts (rms) per channel
At 8 ohms	7 watts (rms) per channel
Damping factor	>30 (with a 4 ohm load)
Control/remote — ampli	fier

Control port	(1) 3.5 mm captive screw connector, 3 pole
Pin configuration	Pin 1 = +10 VDC, pin 2 = volume/mute (variable voltage), pin 3 = GND
Volume control voltage range	0 V (mute) to 10 V (maximum volume)

General

External power supply	100 VAC to 240 VAC, 50/60 Hz, external; to 12 VDC, 3 A (max.), regulated
Power input requirements	12 VDC, up to 3 A
Temperature/humidity	Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing
Cooling	Convection, vents on top and sides
Mounting	
Rack mount	Yes, with optional 1U, 9.5" deep rack shelf (RSU 129, #60-190-01, or RSB 129, 60-604-01); 1U, 6" deep rack shelf (RSU 126, #60-190-10, or RSB 126, 60-604-10); or VersaTools [®] 1U, 3.5" deep rack shelf (RSF 123, #60-190-20, or RSB 123, 60-604-20)

Extron MPA 122 Mini Power Amplifier • Specifications 1

V 1.7 25 Jan 2016

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Supply voltage	Vcc	3.0	12.0	V
Storage temperature	Ts	-10	+50	°C
Operating temperature	To	+5	+50	°C
ESD endurance	Vesd		±20	kV

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Conditions	Min	Тур	Max	Unit
Supply voltage	Vcc	T=25°C		5.0		V
Supply current average	Iavg	T=25°C Vcc=5.0V		25		mA
Storage temperature	Ts			+25		°C
Operating temperature	To			+25		°C
Detection time from	Δt	T=25°C Vcc=5.0V		4		s
hands						
Wireless reception	1	T=25°C Vcc=5.0V	80		105	cm
range (typical)*						

*) Can be changed on request

ELECTRICAL CHARACTERISTICS BY PIN

Function
ESD protection to chassis connector
Ground
Left reference electrode connection. Left hand fingertips.
Left active electrode connection. Left hand palm.
Ground
Right reference electrode connection. Right hand fingertips.
Right active electrode connection. Right hand palm.
Left reference electrode connection. Left hand fingertips.
Left active electrode connection. Left hand palm.
Right active electrode connection. Right hand palm.
Right reference electrode connection. Right hand fingertips.
Output S, separate output
Output C, combined output
Vcc
Ground

Polar Electro Inc - OEM Division

1111 Marcus Avenue, Suite M15 Lake Success, NY 11042-1034, USA Tel. +1 516 364 0400 Fax. +1 516 364 5454

Polar Electro Europe AG

Sumpfstrasse 13 CH-6300 Zug, Switzerland Tel. +41 41 727 1177 Fax. +41 41 727 1166

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BOARD DIMENSIONS

Dimension	Value
Length	50.1 mm
Width	24.4 mm
Height	6.50 mm
Connector spacing	2.54 mm

NOTE: Connectors excluded

ORDERING INFORMATION

Currently available versions from stock and list of functions on standard models

Board number	Board name
94051253	NANO5G
94052951	NANO 5G PCL20 SMAW250
94056492	NANO 5G PCL20MA
94058359	NANO 5G SRL SO1
94058360	NANO 5G PSL20

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PIN CONFIGURATION

Note: Arrow head marks the pin 1 on array J2.

PIN DESCRIPTION

Pin name	Function
J1	ESD protection to chassis connector
J2 (1)	GND
J2 (2)	Left reference electrode
J2 (3)	Left signal electrode
J2 (4)	GND
J2 (5)	Right reference electrode
J2 (6)	Right signal electrode
J3 (1)	Left reference electrode
J3 (2)	Left signal electrode
J3 (3)	Right signal electrode
J3 (4)	Right reference electrode
J4 (1)	Output S
J4 (2) *	Output C
J4 (3)	Vcc
J4 (4)	GND

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USB to DMX Dongle

A USB dongle used for controlling 1 universe (512 channels) of DMX. The dongle uses the FTDI chipset and is Open DMX compatible.

Non isolated and with ESTA RJ45 pinout.

NOTE: new dongle design has send and receive leds and a male plug on a 10cm lead

Dongle ships with a RJ45 joiner as linked too below.

Open dmx FTDI drivers can be downloaded from http://www.ftdichip.com/Drivers/VCP.htm if required

Guides on installing the drivers can be found at http://www.ftdichip.com/Documents/InstallGuides.htm

This dongle can be run as an Open DMX device under Light-O-Rama, LightShowPro, Vixen or Xlights lighting softwares.

The dongle can also be used for controlling Light-O-Rama boards instead of the genuine LOR dongles. The LOR-ESTA adaptor below or a crossover cable is required to change from the ESTA pinout to the LOR one. Details of that can be found at

http://auschristmaslighting.com/wiki/DMX_Adapter_Leads#Reversible_DMX.2FLOR_Adapter

For testing your lights I recommend using da_dmx that David Duffy from www.audiovisualdevices.com.au has on www.da-share.com/software/da_dmx

Teensy

Specifications

- ARM Cortex-M4 at 72 MHz
- 256K Flash, 64K RAM, 2K EEPROM
- USB device 12 Mbit/sec
- 34 digital input/output pins, 12 PWM output pins
- 21 analog input pins, 1 analog output pin, 12 capacitive sense pins
- 3 serial, 1 SPI, 2 I2C ports
- 1 I2S/TDM digital audio port
- 1 CAN bus
- 16 general purpose DMA channels
- RTC for date/time

Compare detailed specifications of all Teensy models.

Software

Arduino IDE + Teensyduino

<u>Arduino's IDE software with the Teensyduino add-on</u> is the primary programming environment for Teensy. On Windows, Linux and old Macs, Arduino is installed first and then the Teensyduino installer adds Teensy support to the Arduino IDE. On newer Macs, an all-inone download is provided. Teensyduino includes a large collection of libraries which are tested and optimized for Teensy. Other libraries may be installed manually or by Arduino's library manager. **APPENDIX III - PACKING**

Instructions and Photos

The following components should be wrapped and packed separately: lightbulbs and spare light bulbs, internet router and cables, wall brackets, and finally, the corian unit.

For each Corian unit, place the object face-down (hand plates facing downwards). Wrap each unit in pink anti-static plastic, then multiple layers of thick bubble wrap. Place both white and pink foam at the bottom of the crate or travelling case, then lay the wrapped unit on top.

Use as much packing material as necessary to ensure that each unit and its components do not vibrate or move during transport, and to prevent any chipping or damage to the stone surface.

