Towards a 4D Breast Phantom for Radiotherapy QA

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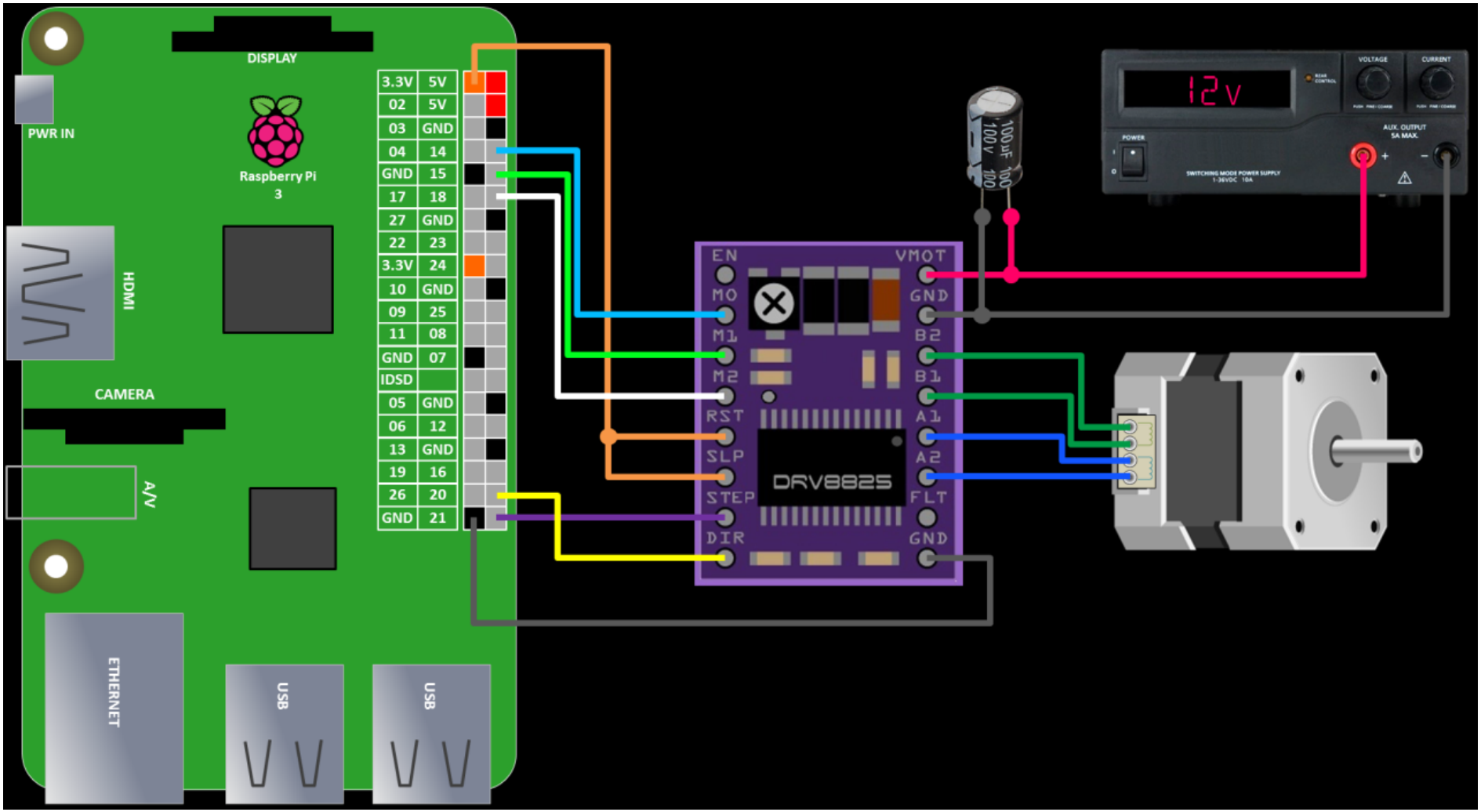
Motivation

- Motion in imaging and treatment can pose an issue..
  - Breath hold/gated treatments
  - CyberKnife motion-tracking
  - Motion artifacts in IGRT
- Currently, only available QA phantom is by QUASAR
  - Very expensive
  - Not full 4D capabilities
- Desire for more accessible alternative

Overview of Project

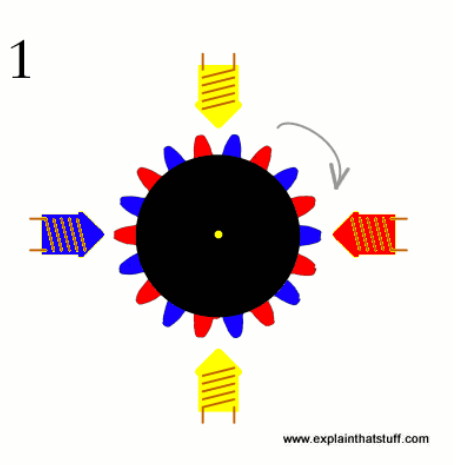
- Want to
  - Take in a breathing trace
  - Convert it into mechanical motion
- Needs to be
  - Standalone
  - "Perfect" temporal and spatial accuracy
  - Open-source and cheap
- How to?
  - Raspberry Pi $\rightarrow$ Stepper motor
  - Rotational motion $\rightarrow$ Linear motion

Circuitry

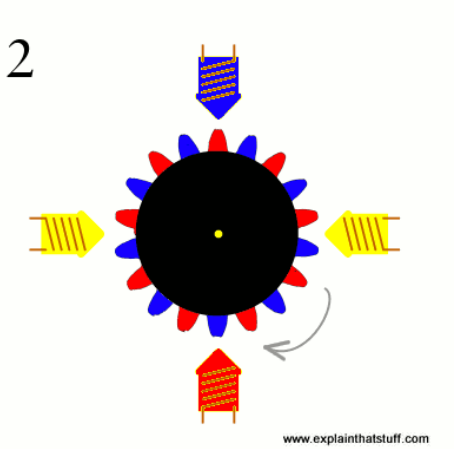

DISPLAY
PWR IN
Raspberry Pi
3
HDMI
CAMERA
A/V
ETHERNET
USB
USB
3.3V 5V
02 5V
03 GND
04 14
GND 15
17 18
27 GND
22 23
3.3V 24
10 GND
09 25
11 08
GND 07
IDSD
05 GND
06 12
13 GND
19 16
26 20
GND 21
EN
MO
M1
M2
RST
SLP
STEP
DIR
VMOT
GND
B2
B1
A1
A2
FLT
GND
DRV8825
100µF 100V
12V
VOLTAGE
CURRENT
POWER
AUX. OUTPUT
5A MAX.

Stepper Motors

- Step-based
  - Define the angle of rotation
  - Perfect spatial accuracy



- PWM-based
  - Define the frequency of rotation
  - Perfect temporal accuracy



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https://github.com/clund12/MDPH612-project