VIBRO CONTROL

vibro-tactile biofeedback framework

wearHEALTH

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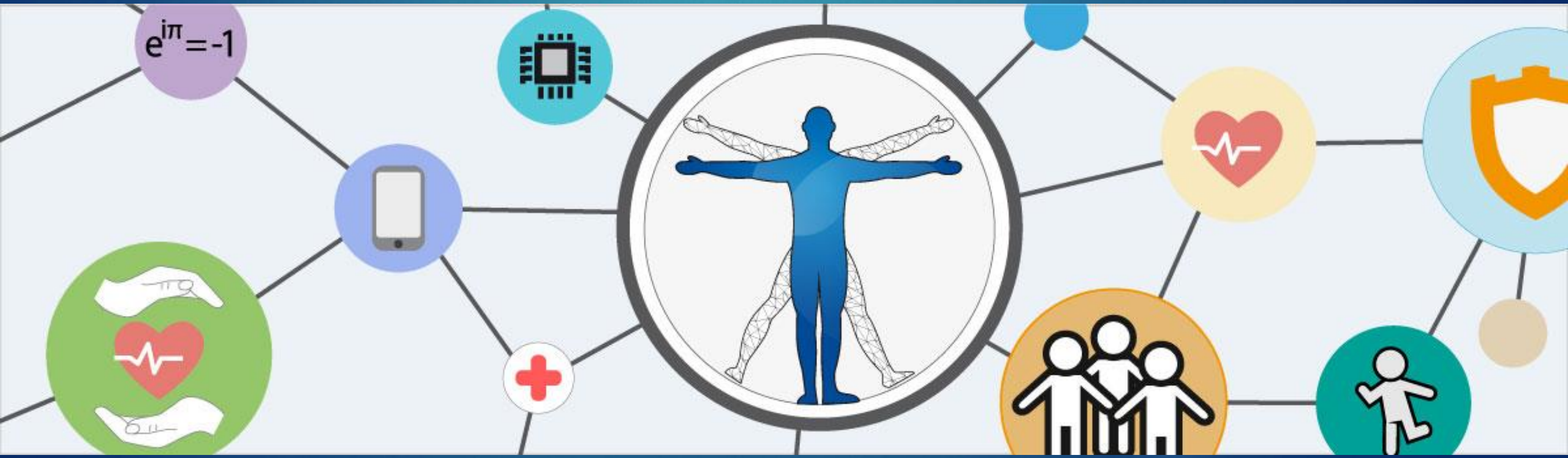

VIBRO CONTROL HW/SW-FRAMEWORK

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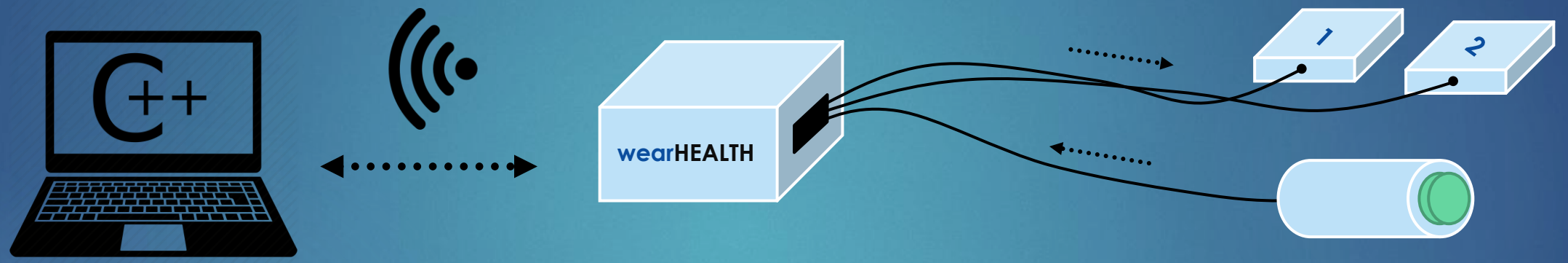
C++ frontend / API

HW/SW backend / controller unit

actuator / sensor modules



hardware:

- any PC or notebook (WiFi enabled)
- later: mobile phone

software:

- lightweight C++ API implementing the device interface (commands)
- any specific user or study app on top of the API

hardware:

- microcontroller board
  - microcontroller (ESP32)
    - GPIOs, timers, PWM, I2C, SPI, ...
  - FTDI chip (serial USB)
- battery (LiPo)
- communication module (WiFi, BLE, LoRa, ...)
- actuator power electronics

software:

- C/C++ app on top of FreeRTOS API

hardware:

- actuators
  - packaged vibro-tactile actuators, e.g.:
    - vibration motors
    - piezo elements
    - voice coils (auto-tactile exciters)
    - ...
- sensors
  - simple buttons for user-feedback
  - later: various body-worn sensors

VIBRO CONTROL HW/SW BACKEND

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microcontroller board

„smallest ESP32 dev. board“

ESP32 (espressif), 3.3VDC

Xtensa LX6, 2 cores

@ max. 240MHz

520kB SRAM

external Flash: 4MB

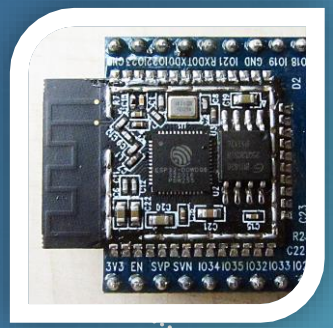
WiFi + BLE (2.4 GHz)

3x UART, 4x SPI, 2x I2C, 2x I2S,

12bit ADC, 2x 8bit DAC

16 channel PWM (motor + LED)

10 capacitive sensing GPIOs



external antenna

2.4GHz PCB antenna

mini RF coax.

actuator-specific

power electronics / drivers

?

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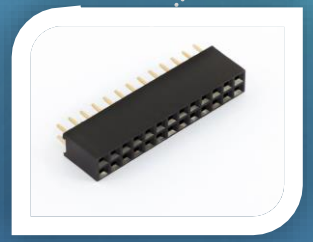
battery

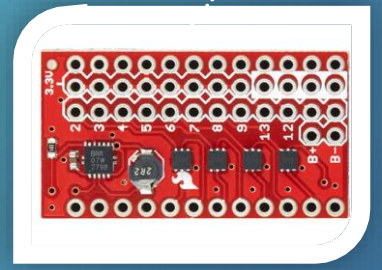
lithium ion 3.7V, 750 mAh



generic IO

pin header, up to 4

actuators or sensors

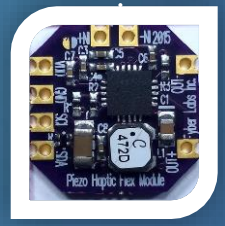


motor power shield

8 channel FET shield

3.3V, 800 mW max.

PWM: 0 – 3.3VDC



piezo driver

TI DRV2667, I2C

boost converter

3.3V ➔ 100Vpp

audio amplifier

class D amp

I2S, 3W

VIBRO CONTROL ACTUATORS

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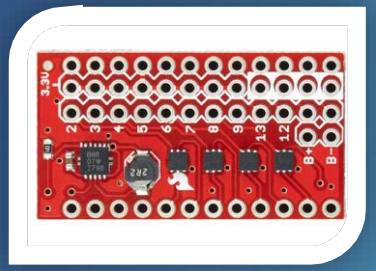
motor actuator



motor power shield

8 channel FET shield

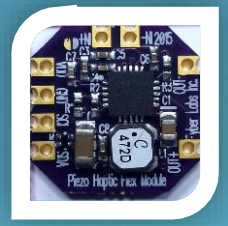
3.3V, 800 mW max.

PWM: 0 – 3.3VDC

eccentric rotating mass motors

- small working range
- vibration amplitude and frequency are directly related
- quite noisy

piezo actuator



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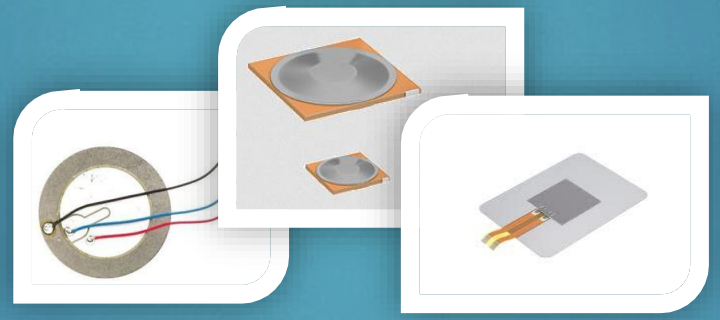

piezo elements

- 2 major types: benders and expanders
- high voltages: 20 – 120Vpp
- follow AC signal closely
- control vibration amplitude and frequency independently
- quiet but not too powerfull

voice coil actuator

audio amplifier

class D amp

I2S, 3W

experimental

voice coils / body-borne sound exciters

- similar to loudspeaker
- follow AC signal closely
- control vibration amplitude and frequency independently
- maybe noisy (?) but hopefully powerful (?)
- huge frequency range: 10Hz – 20kHz