Electrogoniometer for gait analysis

Potentiometer

Technologies for sensors and clinical instrumentations

ALIVERTI C.
PAGANELLI C.
ANGELUCCI A.

TEAM 4:
BOUQUILLON Mylène, 10905159
DESIDE Guillaume, 10905967
MATERNE Sophie, 10872639
MEDRANO Estanislao, 10916969
PESKIR Aleksa, 10877580
SCHNIRER Tobias, 10912716

POLIMI – 06/06/2023

Angular variations of the body joints (hip, **knee**, ankle)

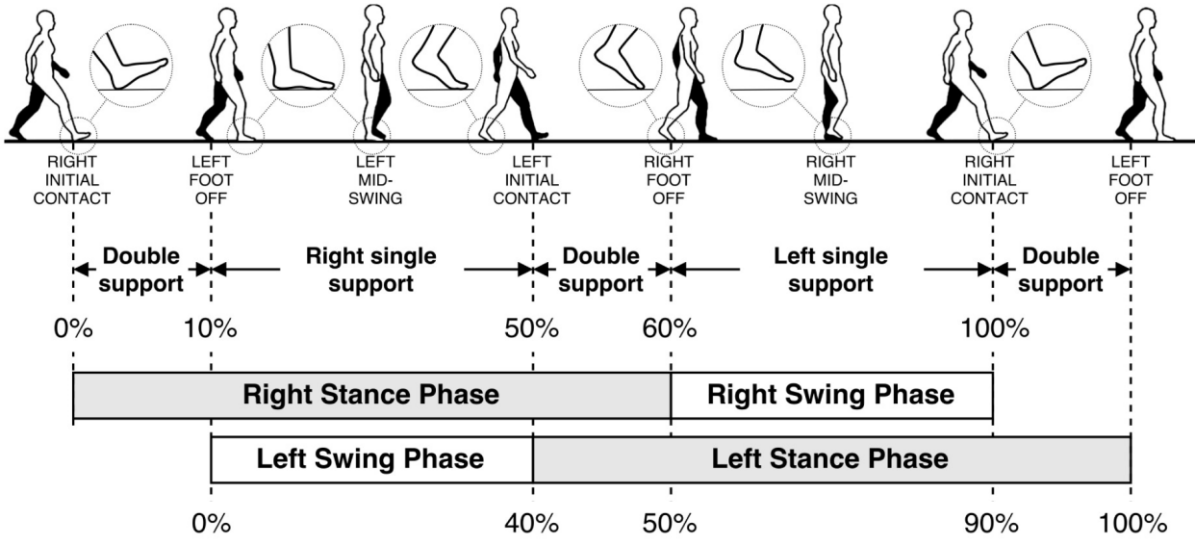
Continuous monitoring
Daily activities
→ Functionnal status of the patient

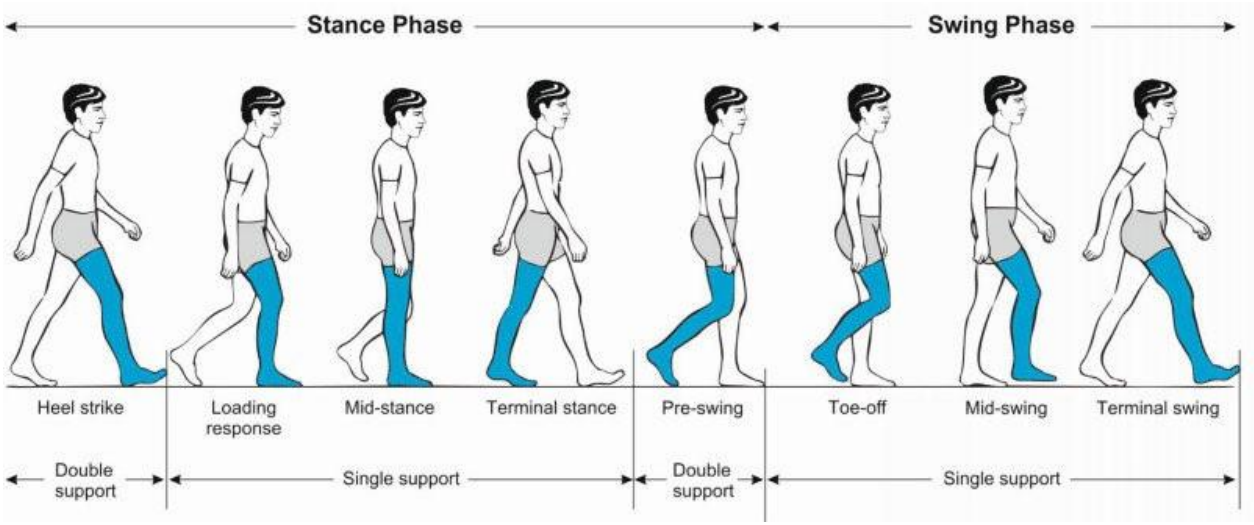
Electrogoniometer for gait analysis

Joint limitations, individual therapeutic needs, tailored rehabilitation plans, athletes performances, feedback for prosthetic control systems, ...

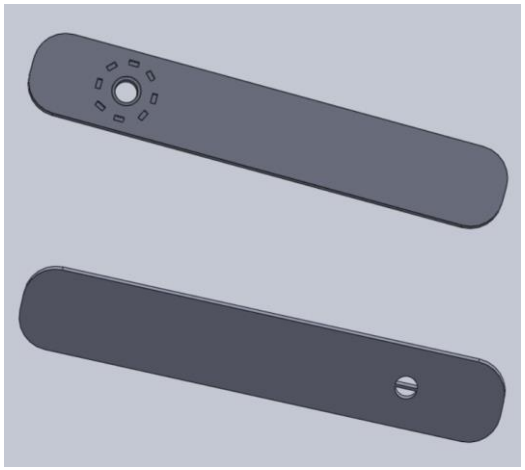
Potentiometer
(small size, long life span, ease of use, ~~clothing interferences~~)

Arduino microcontroller
(compact size, robust, extensive community support)

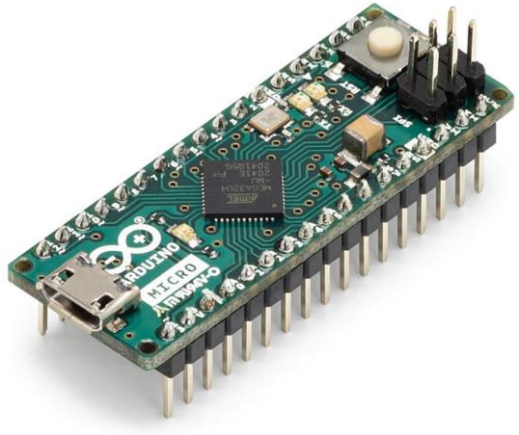

RIGHT INITIAL CONTACT
LEFT FOOT OFF
LEFT MID-SWING
LEFT INITIAL CONTACT
RIGHT FOOT OFF
RIGHT MID-SWING
RIGHT INITIAL CONTACT
LEFT FOOT OFF
Double support
Right single support
Double support
Left single support
Double support
0%
10%
50%
60%
100%
Right Stance Phase
Right Swing Phase
Left Swing Phase
Left Stance Phase
0%
40%
50%
90%
100%


Stance Phase
Swing Phase
Heel strike
Loading response
Mid-stance
Terminal stance
Pre-swing
Toe-off
Mid-swing
Terminal swing
Double support
Single support
Double support
Single support

3D structure

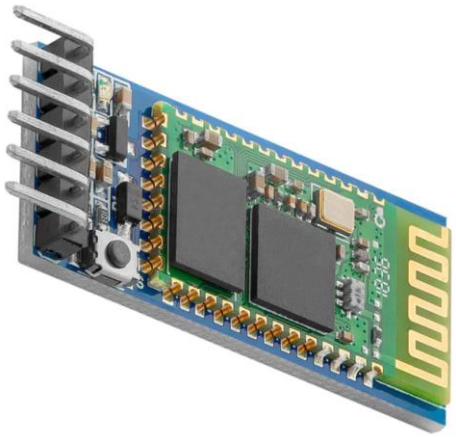


Arduino microcontroller board



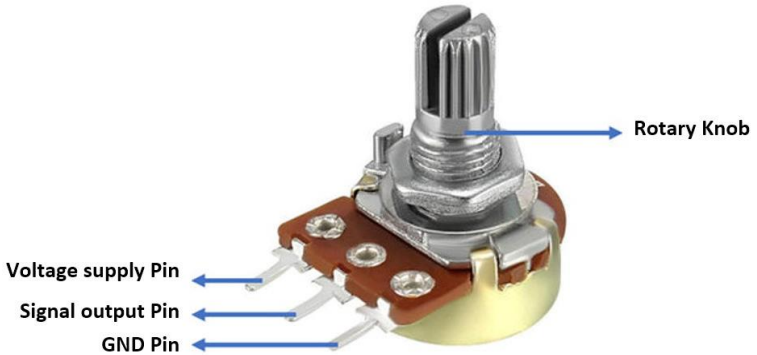
Potentiometer

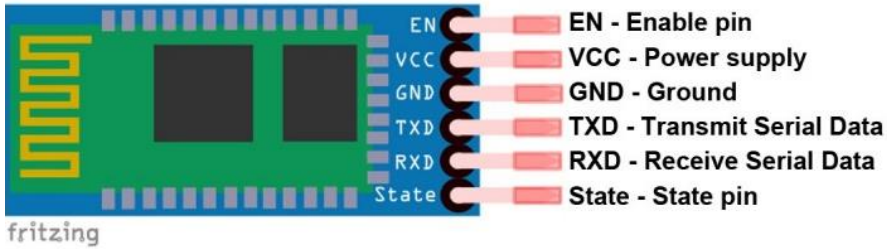
Bluetooth module

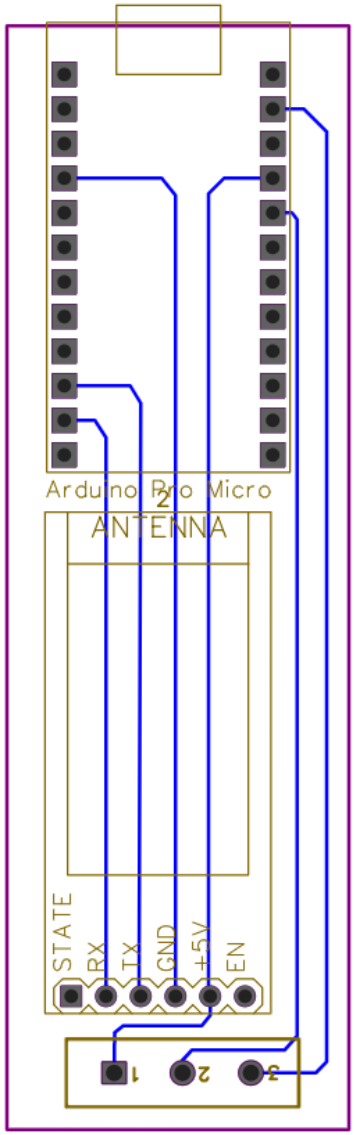


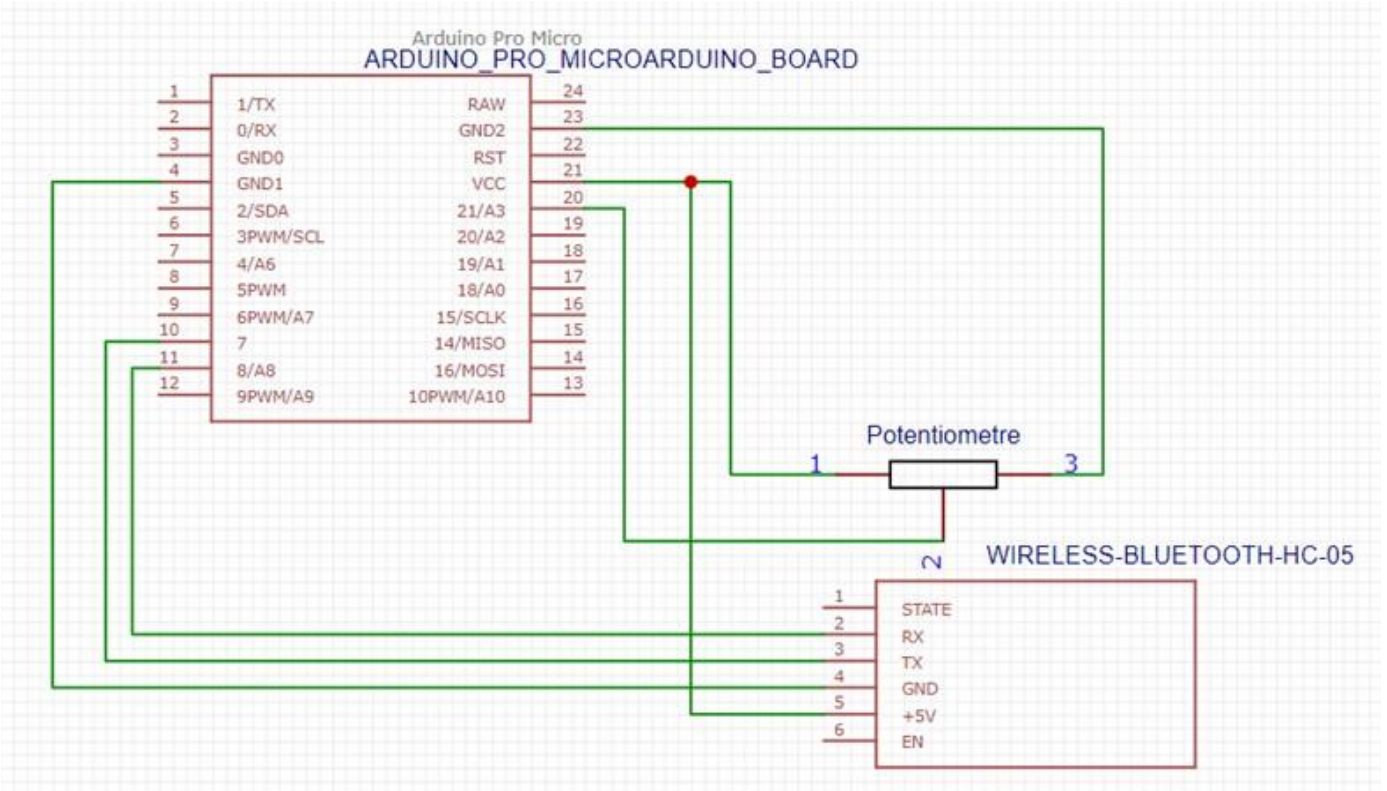
Arduino	Potentiometer
A3	Signal output Pin
5V	Voltage supply Pin
GND	GND Pin

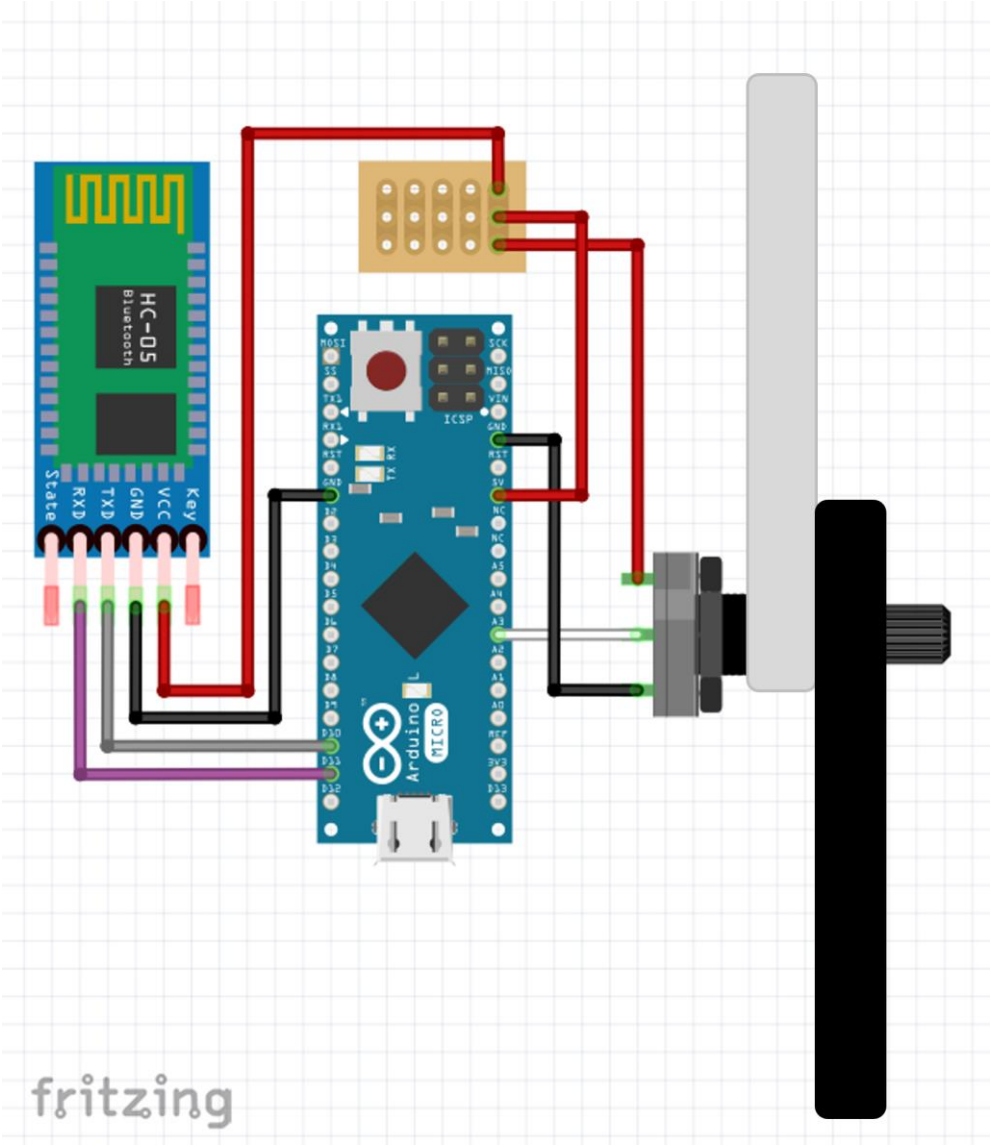
Arduino	Bluetooth
10	TX (= TXD)
11	RX (= RXD)
5V	VCC
GND	GND



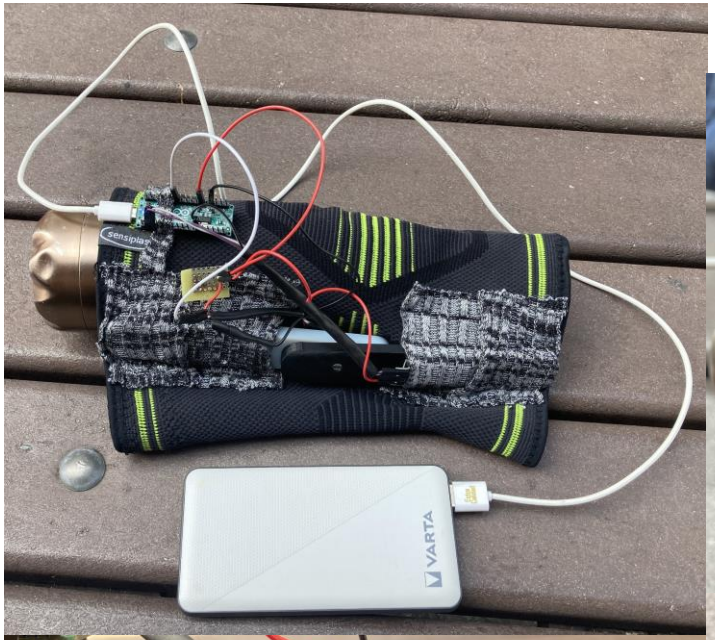


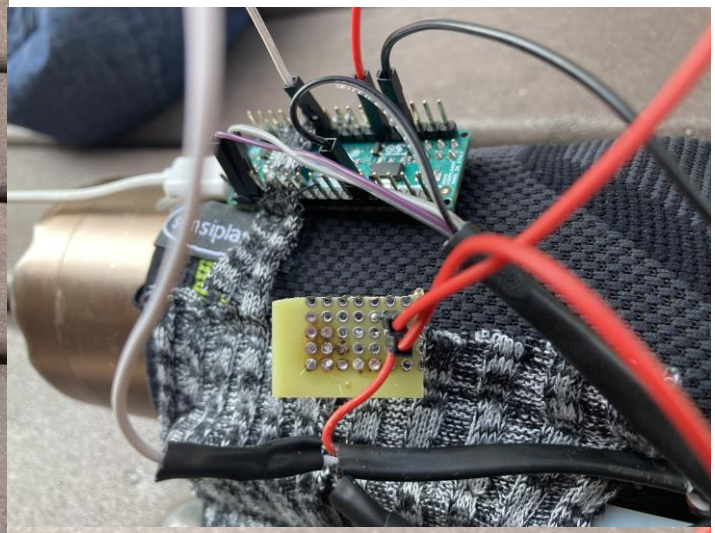

Arduino Pro Micro
ANTENNA
STATE
RX
TX
GND
+5V
EN
1
2
3

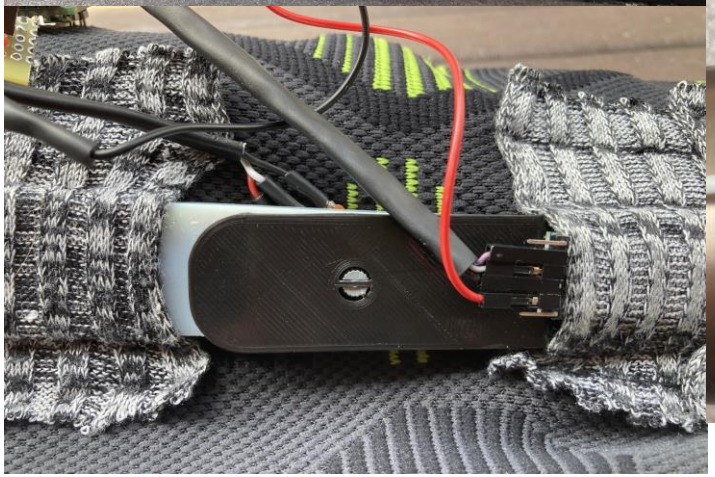

Arduino Pro Micro
ARDUINO_PRO_MICROARDUINO_BOARD
1/TX
0/RX
GND0
GND1
2/SDA
3PWM/SCL
4/A6
5PWM
6PWM/A7
7
8/A8
9PWM/A9
RAW
GND2
RST
VCC
21/A3
20/A2
19/A1
18/A0
15/SCLK
14/MISO
16/MOSI
10PWM/A10
Potentiometre
WIRELESS-BLUETOOTH-HC-05
STATE
RX
TX
GND
+5V
EN


HC-05
Bluetooth
State
RXD
TXD
GND
VCC
Key
ICSP
Arduino
MICRO
fritzing

HARDWARE – Assembly







THANK YOU

Any questions?

[1] C. Adel, Y. Benabid, and M. A. Louar. "Design and implementation of an electronic goniometer for gait analysis". In: *Computer Methods in Biomechanics and Biomedical Engineering* 20.sup1 (2017), S3–S4. DOI: 10.1080/10255842.2017.1382832.

[2] Christin Büttner, Thomas L. Milani, and Freddy Sichting. "Integrating a Potentiometer into a Knee Brace Shows High Potential for Continuous Knee Motion Monitoring". In: *Sensors* 21.6 (2021). ISSN: 1424-8220. DOI: 10.3390/s21062150. URL: https://www.mdpi.com/1424-8220/21/6/2150.

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[5] E. Maranesi et al. "A goniometer-based method for the assessment of gait parameters". In: (2014), pp. 1–4. DOI: 10.1109/MESA.2014.6935539.

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