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DEVELOPMENT OF A SYMBIOTIC GUI FOR ROBOTIC & PROSTHETIC HAND

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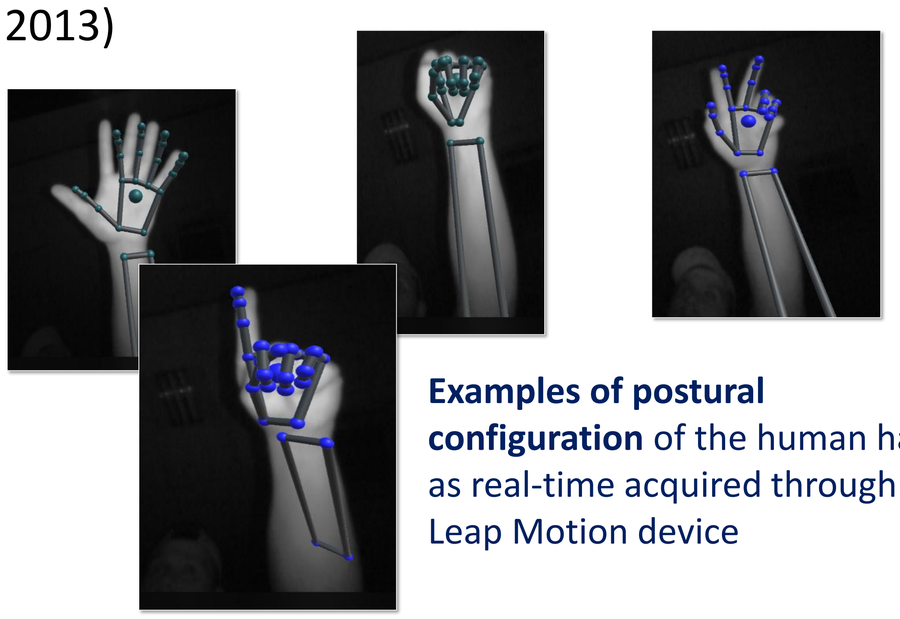
RATIONAL - We present the design & prototyping of a fully integrated *symbiotic* prosthetic hand. Current prostheses in the market lack of intuitiveness in control. Here we provide a novel fingers' control through Leap Motion technology, namely the movements performed by a human hands are mapped and transferred into the prosthetic hand to achieve desired grasping configuration. An intuitive Graphical User Interface (GUI) is developed in order to enable amputees to select which hand position they want vs given daily-life task of grasping.

2 - The Hand – The *Open Bionic Hand* is a 5-fingers 3D printed hand equipped with 5 linear Firgelli actuators and an Arduino-compatible (2560) on board controller. It is an underactuated hand with generous grasping capability. Thanks to its open-source based controller it can be easily interfaced with multiple types of software and hardware (www.openbionics.com; Arduino, S.A., 2015).

Robotic Hand Palm
Material: Ninja flex
Mass: 160 g
Mass with support: 200 g
Print time: 26 hours
Bounding box: 180 x 200 x 45 mm

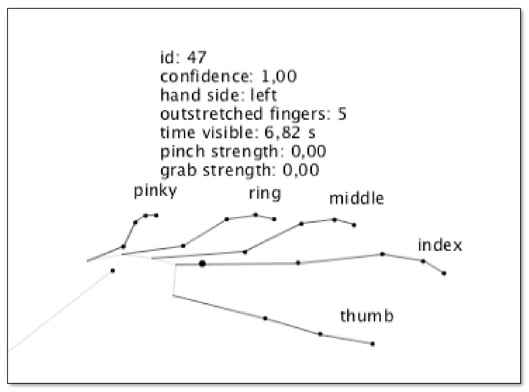
source: www.openbionics.com

1 - The Sensor – The *Leap Motion* controller is a commercial device which allows marker less caption of the human hand movements (i.e. wrist postural configuration, grasping configuration and phalanges' angular displacements). It is based on proprietary 3D image processing techniques (two cameras and three infrared LEDs capable of tracking hand movements in all the three spatial dimensions – see fore example, Weichert F, Bachmann D, Rudak B and Fisseler D, 2013)



Examples of postural configuration of the human hand as real-time acquired through the Leap Motion device

Visual and 3D reconstruction are processed, refined and plotted into a simplified GUI with hand posture and angular displacement (de.voidplus.leapmotion)



3 - The Solution – The *Open Bionic Hand* is interfaced with the Leap Motion device (1) through a customised GUI (2) developed in Processing (Processing.org)

image from KeyShot.com

```
#include <Servo.h>
Servo Thumb;
Servo Index;
Servo Middle;
Servo Ring;
Servo Pinky;
int c = -1; // int for income value
void setup()
{
  Serial.begin(115200); //set serial with baud rate
  Thumb.attach(3);
  Index.attach(5);
  Middle.attach(6);
  Ring.attach(9);
  Pinky.attach(10);
}

void loop()
{
  if (Serial.available()>0){  //if we have incoming value
    c =Serial.read();
    switch (c){
    case 0: // thumb open
    Thumb.write(0);
```

2

4 - Conclusion – The advantages of the proposed solution are multiple: the system allows very *intuitive and user-friendly training* procedure, is *sustainable*, embeds *simple design*, performs *high dexterity* and is *low cost* (robotic hand ½ KEuro, HW + SW less than 200 Euro)

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This work was presented in dissertation form in fulfilment of the requirements for the Degree of Electronic Engineering and Computer Science for the student Joe Scilio under the supervision of Dr. Emanuele Lindo Secco from the Robotics Laboratory, School of Mathematics, Computer Science and Engineering, Liverpool Hope University.