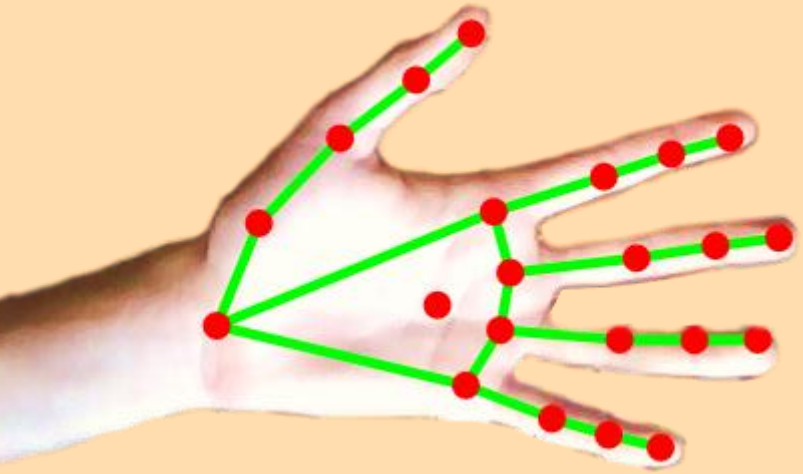
FRANKFURT UNIVERSITY OF APPLIED SCIENCES

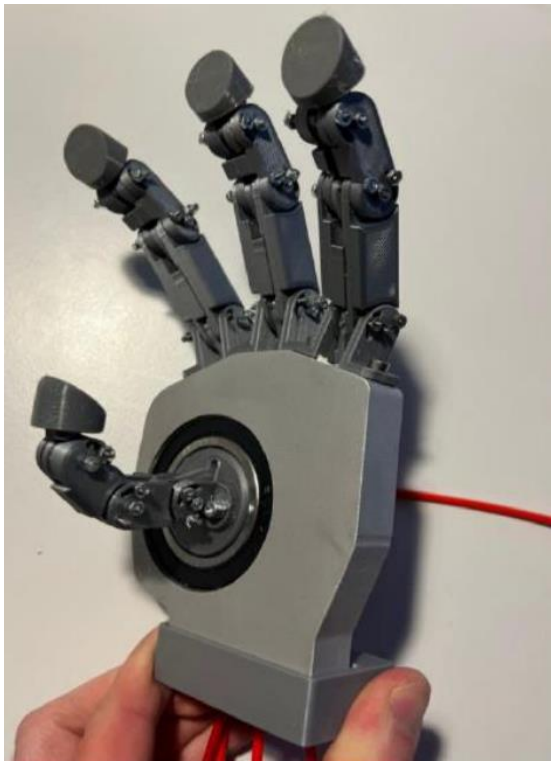
Entwicklung und Umsetzung einer intuitiven Steuerung für eine Roboterhand durch Erfassen der Geste einer menschlichen Hand

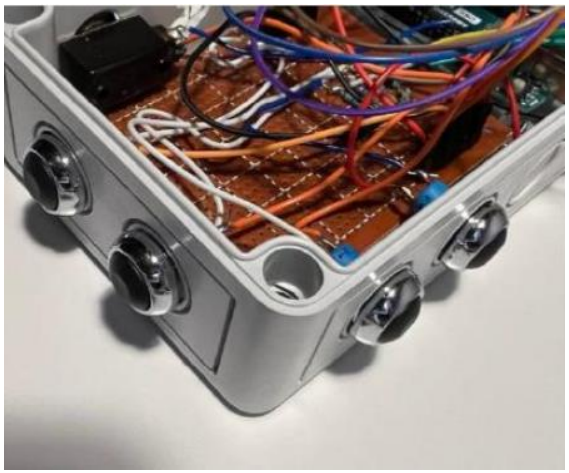


Fachbereich 2 Informatik und Ingenieurwissenschaften

Einleitung

Frankfurter Roboterhand





Control Box

Stand der Technik

- Handschuhe
  - Biegesensoren
  - Inertial Measurment Units (IMUs)

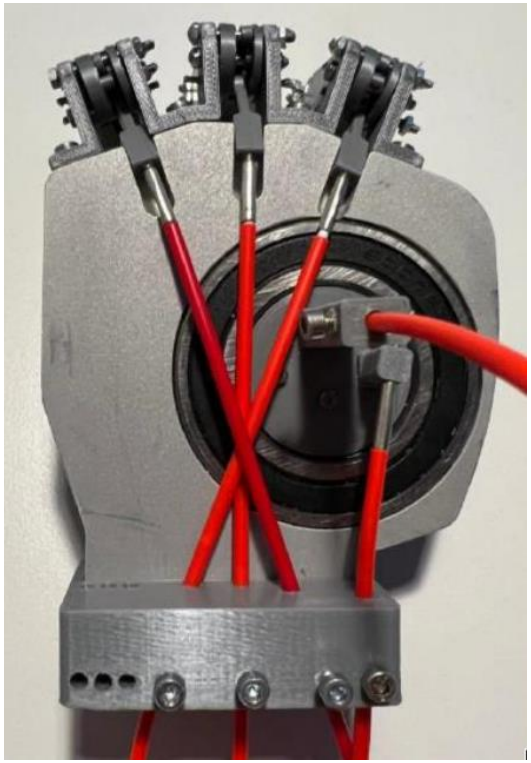
- Motion Capture
  - Triangulation
  - Marker / Mustererkennung

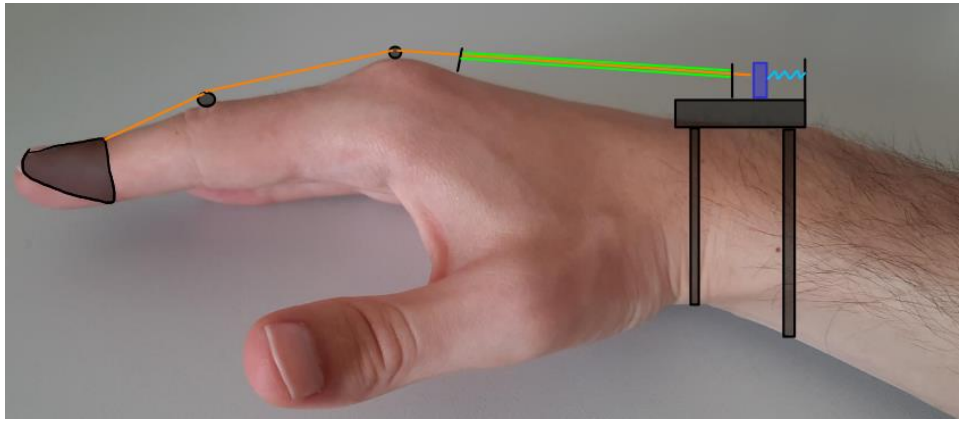
[7]

researchgate.net/figure/Placement-of-the-reflective-marker

https://www.vicon.com/hardware/cameras/

Bowdenzug





Vorteile:

- Finger wie an der Roboterhand
- Feedback Möglichkeit

Nachteile:

- Verrutschen
- Passgröße
- Daumen ungenau

Biegesensor

Widerstandsänderung bei Biegung
→ Power Glove, CyberGlove

Vorteil:
- Vergleichsweise robust

Nachteile:
- Verschiedene Handgrößen
- Kalibrierungsaufwand
- Extra Sensor für Daumen (z.B. IMU)
- Hygiene

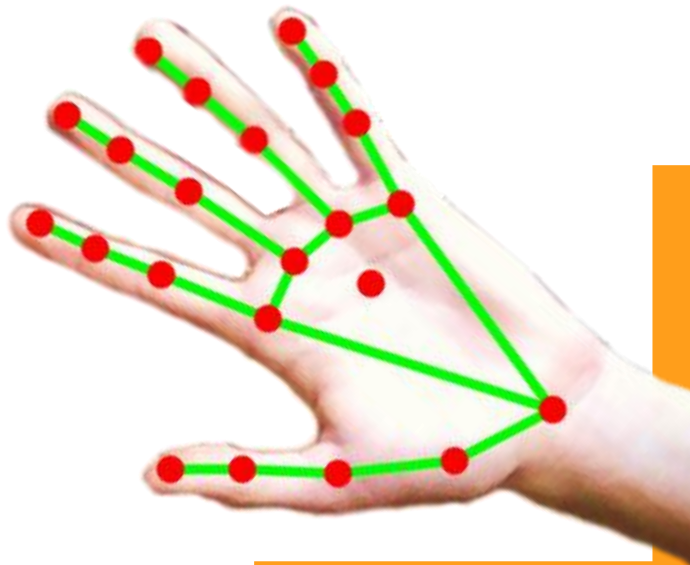
[6]

Bildverarbeitung

Vorteile:
- Modelle vorhanden (Mediapipe)
- beliebige Handgröße
- kein Aufbau & Kalibrierung notwendig
- minimale Investitionskosten

Nachteile:
- höherer Programmieraufwand
- höherer Rechenaufwand

https://mediapipe.dev/assets/img/photos/demo_object_detector.jpg



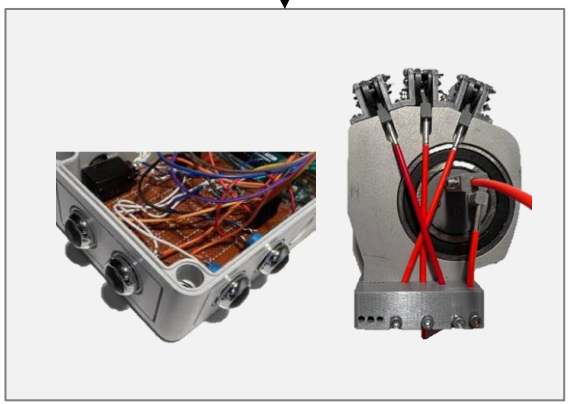
Umsetzung

Server

Client

```
const handsfree = new Handsfree({
showDebug: true, setup: { wrap:
{ $parent: document.querySelector(
'#video-holder') } },
hands:{
enabled:true, // The maximum number of hands to detect [0 - 4]
maxNumHands: 1, // Minimum confidence [0 - 1] for a hand to be
considered detected
minDetectionConfidence: 0.9, // Minimum confidence [0 - 1] for
the landmark tracker to be considered detected
minTrackingConfidence: 0.9 } })
handsfree.start()
// Websocket to send data to: (use python websocketserver for
testing)
var websocket = new WebSocket("ws://localhost:2323");
// initialize callbacks for pinch/release events:
for (let hand = 0; hand < 2; hand++) {
for (let finger = 0; finger < 4; finger++) {
handsfree.on(`finger-pinched-start-${hand}-${finger}`, () => {
const Finger = document.getElementById('F'+hand+finger)
Finger.classList.add('dotRed')
if(hand==0){return;} // send only right hand to server
// Send web_socket - message
websocket.send("finger"+finger+"=pinched");
}) . . .
```

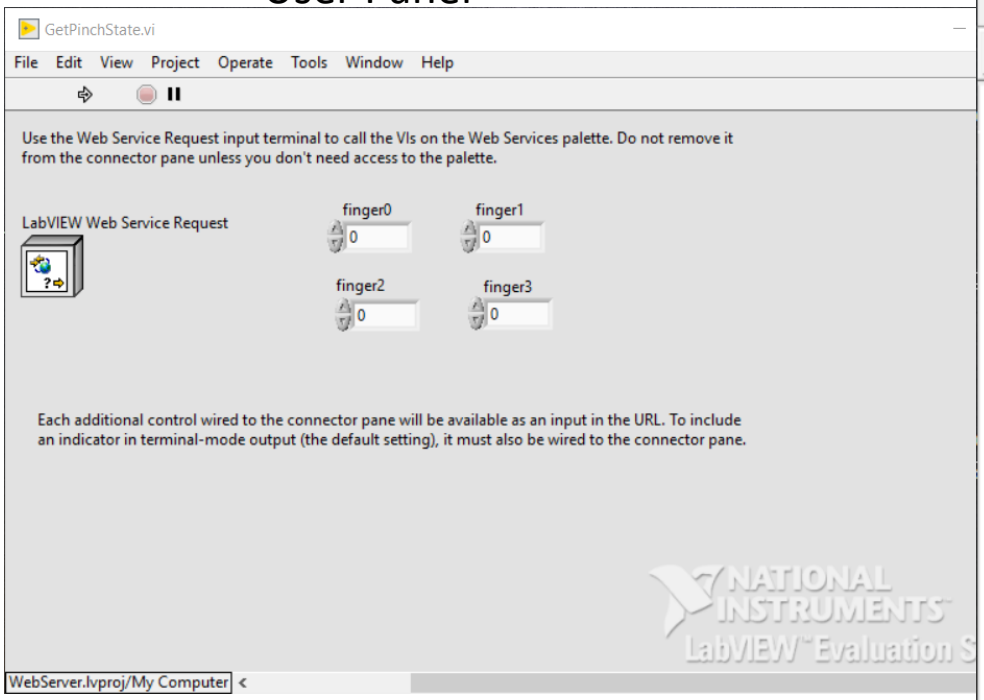
websocket
get-request

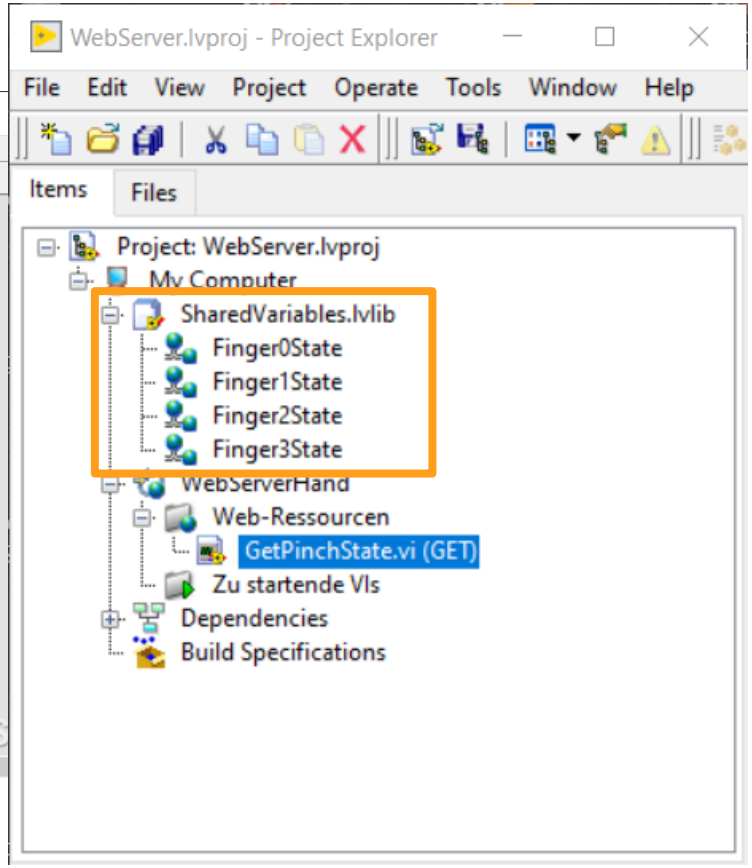


Hardware

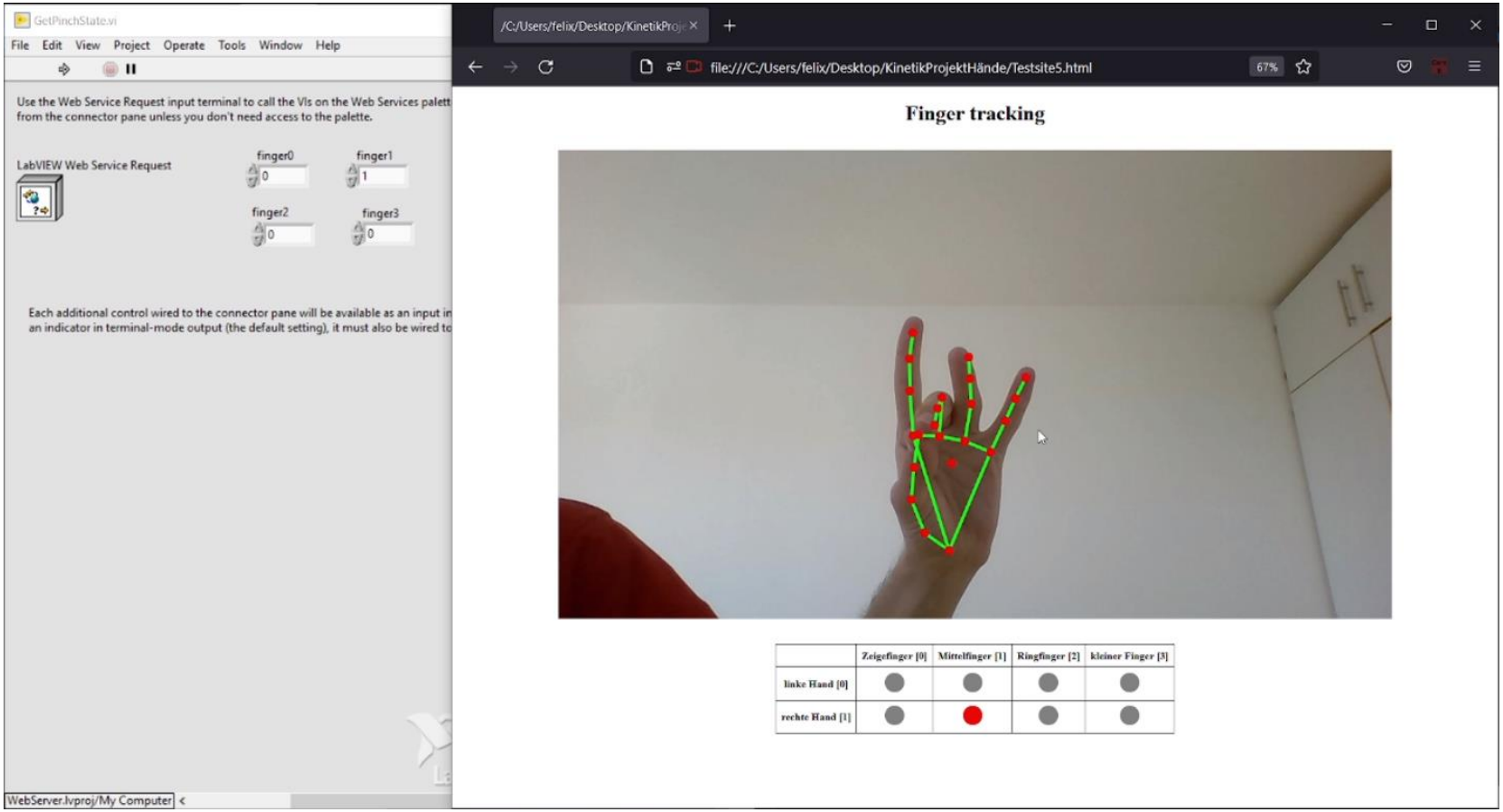
LabVIEW

User Panel





Demo


GetPinchState.vi
File Edit View Project Operate Tools Window Help
Use the Web Service Request input terminal to call the VIs on the Web Services palett
from the connector pane unless you don't need access to the palette.
LabVIEW Web Service Request
finger0
0
finger1
1
finger2
0
finger3
0
Each additional control wired to the connector pane will be available as an input in
an indicator in terminal-mode output (the default setting), it must also be wired to
WebServer.lvproj/My Computer
/C:/Users/felix/Desktop/KinetikProj
file:///C:/Users/felix/Desktop/KinetikProjektHände/Testsite5.html
67%
Finger tracking
Zeigefinger [0]
Mittelfinger [1]
Ringfinger [2]
kleiner Finger [3]
linke Hand [0]
rechte Hand [1]

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Danke

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