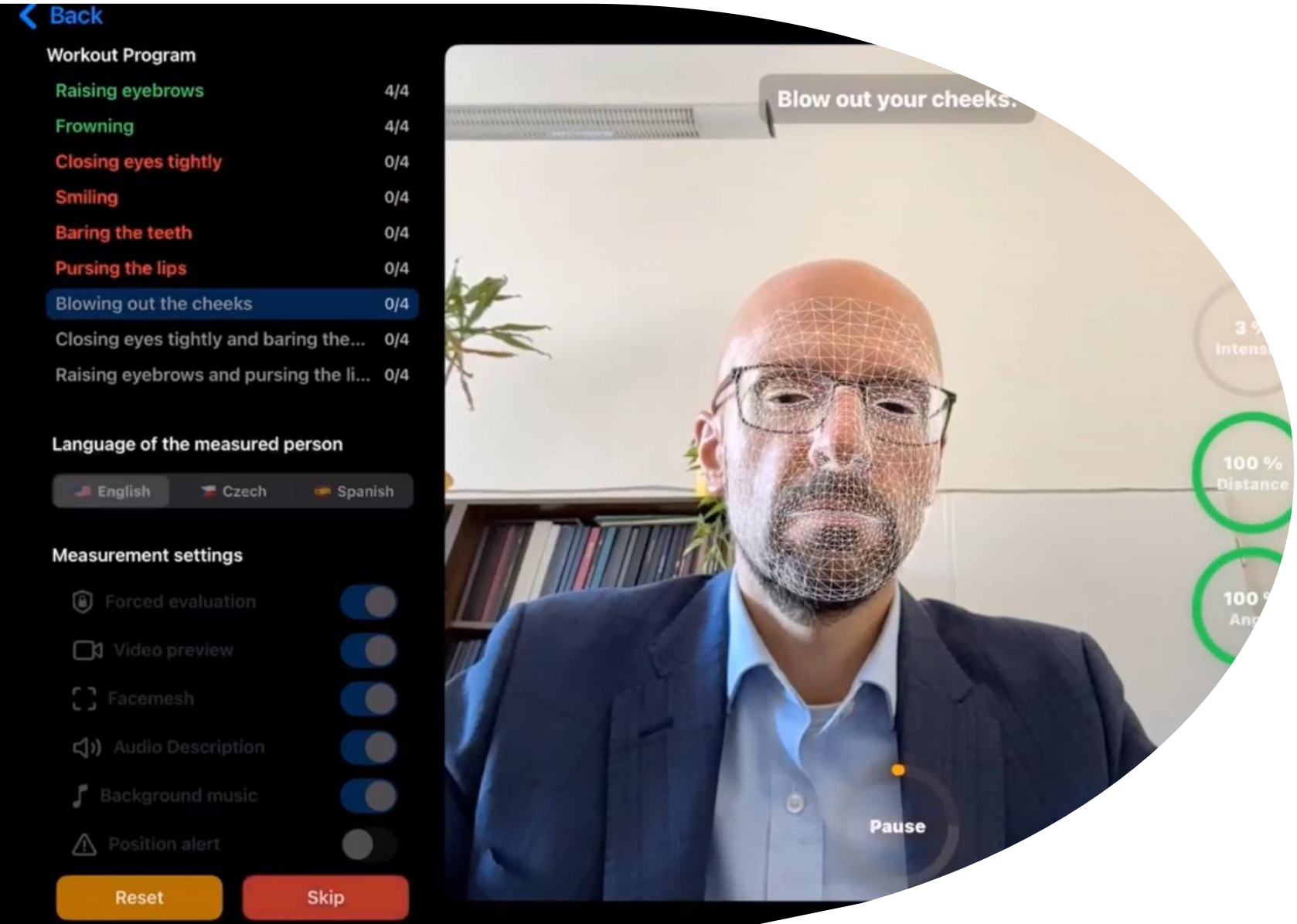
15th International Facial Nerve Symposium
IFNS

optim Research Group of Optimisation and Cybernetics

We love helping people.



A Portable Framework for 3D Facial Movement Analysis Using Consumer Devices in Clinical Evaluation of Facial Nerve Disorders

Speaker: Jan Kohout

Problem

- **Patients** after **head surgery**
  (Vestibular schwannoma)
  - **Lose facial** movements
  - **Balance** problems

- **Clinicians**
  - Limited **capacity**
  - Subjectivity of the HB **score**

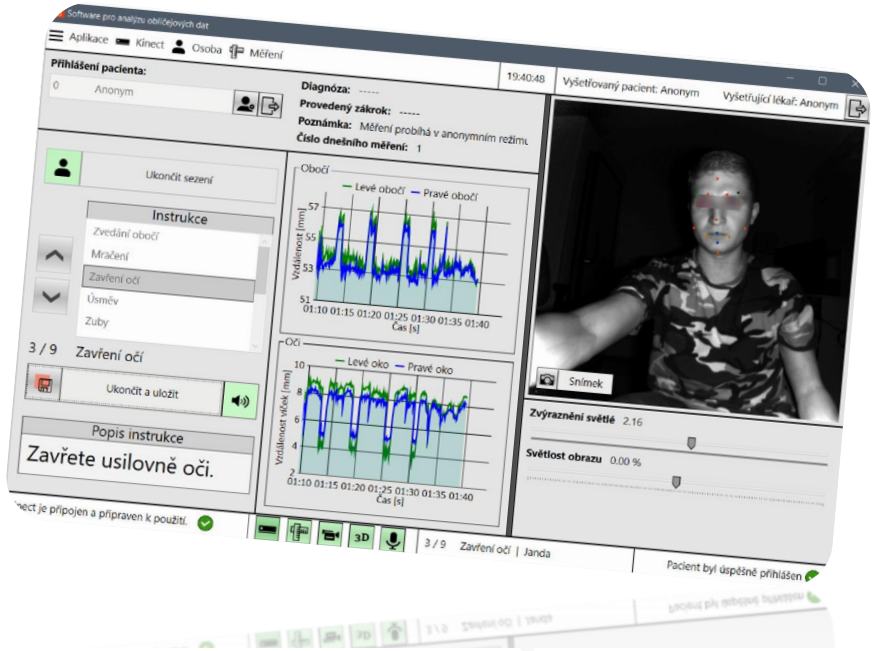
Our Goal

Time saving automatic measurement

Objective rehabilitation **description**

Synkinesis **prevention** and **motivation**

Begining…

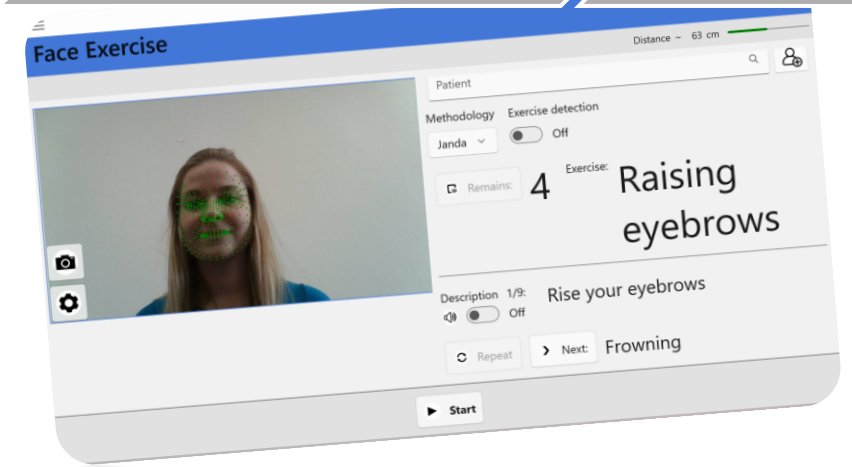


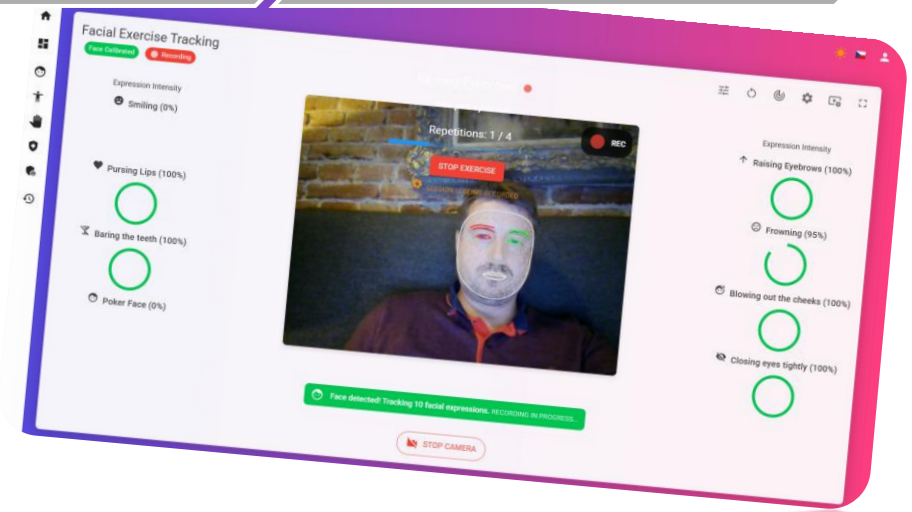
2017
gait disorders

2020
face pilot

2022
app for **windows**

2025
multiplatform





Publications

- Spark et al. (2025). **Multi Path Heterogeneous Neural Networks: Novel comprehensive classification method of facial nerve function.**
- Shayestegan et al. (2024). **Gait disorder classification based on effective feature selection and unsupervised methodology.**
- Shayestegan et al. (2024). **Comparison of Feature Selection and Supervised Methods for Classifying Gait Disorders.**
- Böhm et al. (2024). **Skeleton Detection Using MediaPipe as a Tool for Musculoskeletal Disorders Analysis**
- Shayestegan et al. (2023). **Motion Tracking in Diagnosis: Gait Disorders Classification with a Dual-Head Attentional Transformer-LSTM.**
- Kovarik et al. (2023). **Kinect-Based Evaluation of Severity of Facial Paresis: Pilot Study.**
- Shayestegan et al. (2022). **Advanced Analysis of 3D Kinect Data: Supervised Classification of Facial Nerve Function via Parallel Convolutional Neural Networks.**
- Štícha et al. (2022). **Analysis of Mimetic Muscle Rehabilitation: Data Fusion and Database Development.**
- Červená et al. (2021). **Advanced Statistical Analysis of 3D Kinect Data: A Comparison of the Classification Methods.**
- Kohout et al. (2020). **Advanced Statistical Analysis of 3D Kinect Data: Mimetic Muscle Rehabilitation Following Head and Neck Surgeries.**
- Tomeš et al. (2020). **3D Face Capture for Rehabilitation Progress Assessment After Brain Surgery.**
- Kohout et al. (2018). **Robot-Based Image Analysis for Evaluating Rehabilitation after Brain Surgery.**

Metodology

Data **Acquisition**
(Kinect replaced by **any camera**)

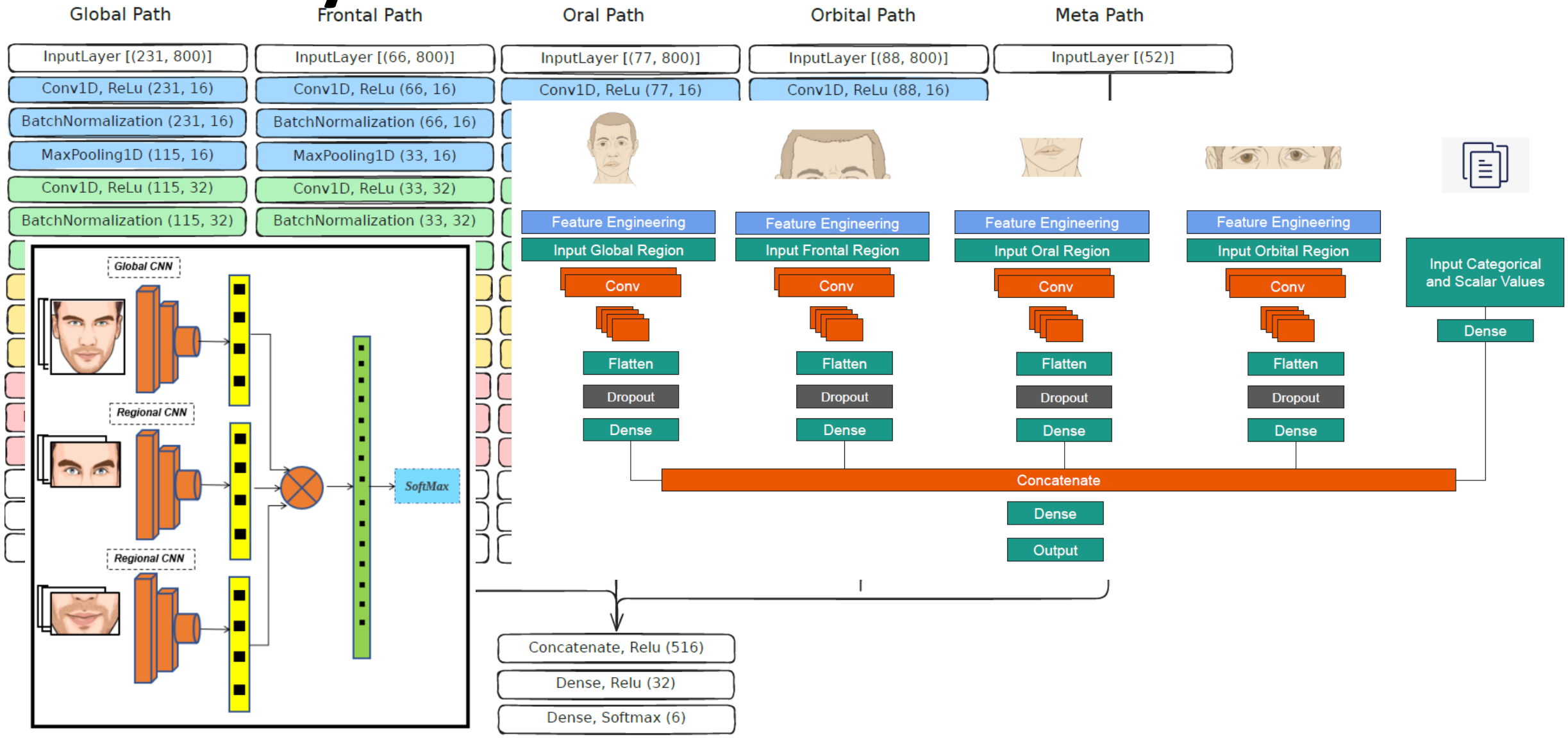
Points of Interest **Analysis**
*(**400 – 1400** points)*

Mathematical **Modeling**
*(population study of **74** subjects)*

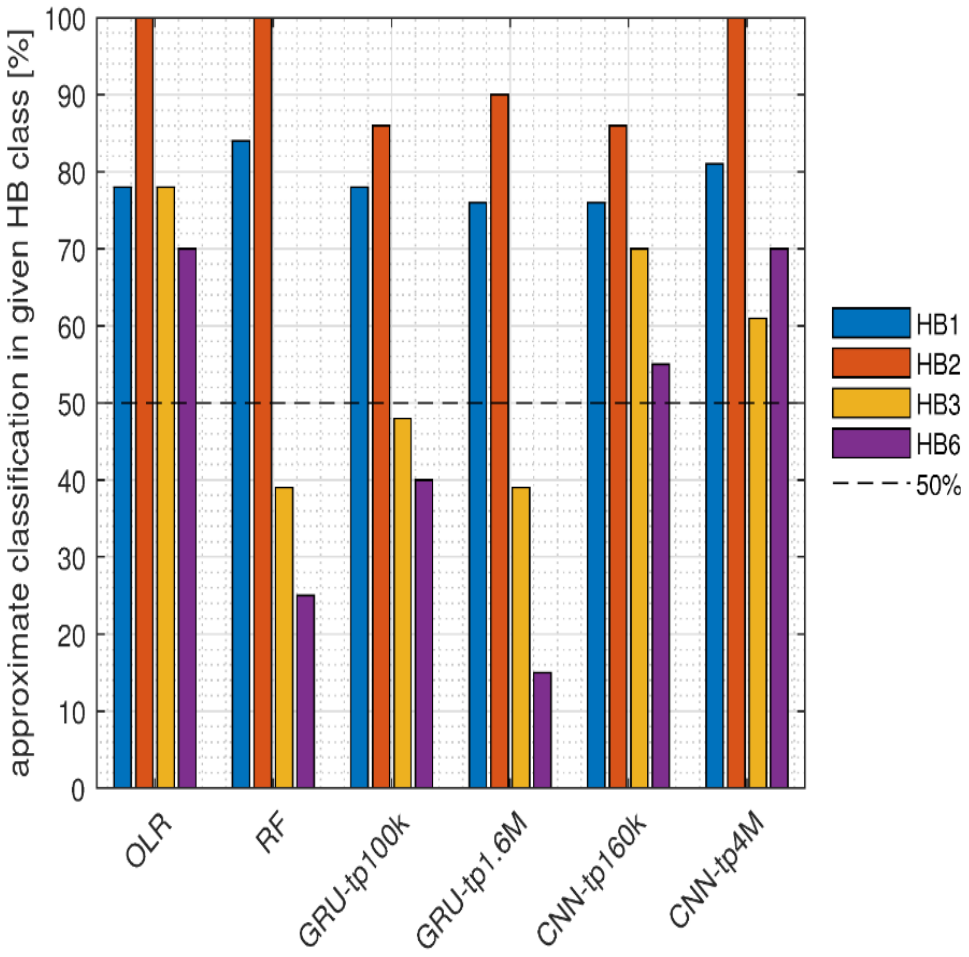
Advanced **Neural Network**

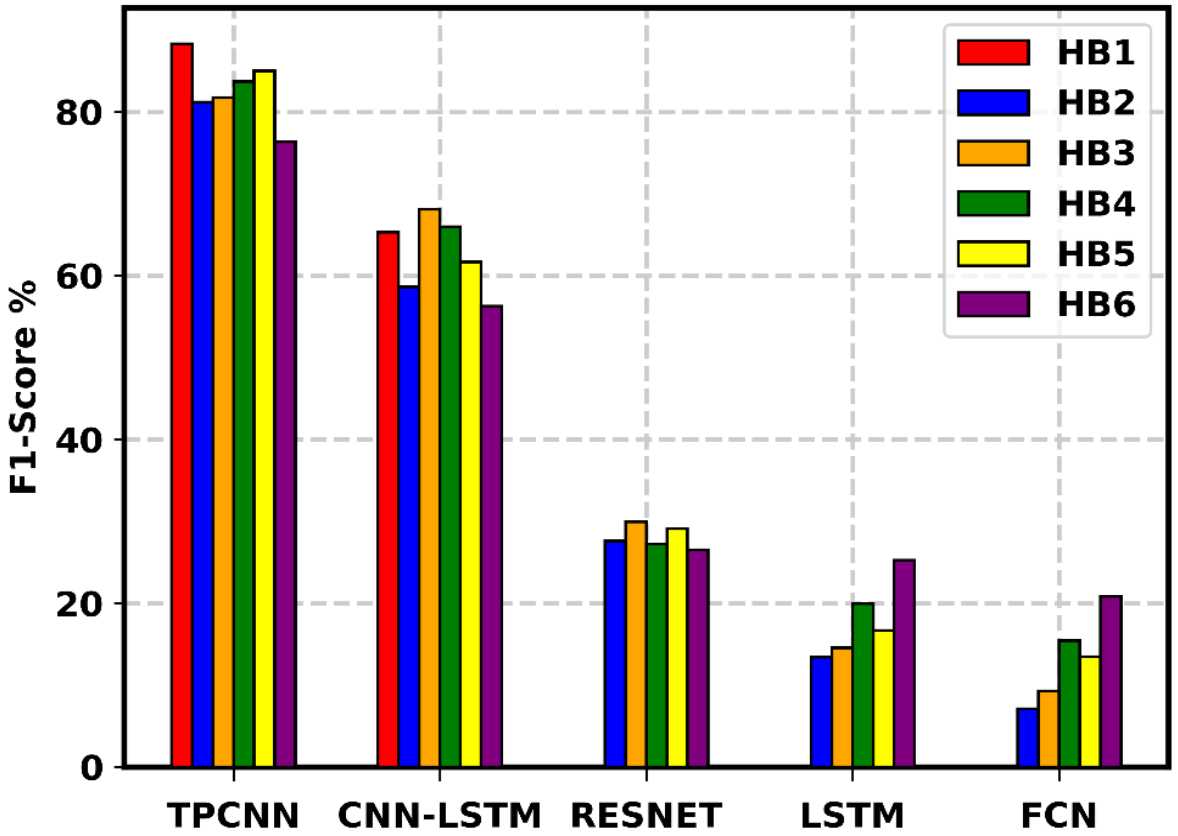
*(based on **250** patients)*

Driven by


Global Path
Frontal Path
Oral Path
Orbital Path
Meta Path
InputLayer [(231, 800)]
Conv1D, ReLu (231, 16)
BatchNormalization (231, 16)
MaxPooling1D (115, 16)
Conv1D, ReLu (115, 32)
BatchNormalization (115, 32)
InputLayer [(66, 800)]
Conv1D, ReLu (66, 16)
BatchNormalization (66, 16)
MaxPooling1D (33, 16)
Conv1D, ReLu (33, 32)
BatchNormalization (33, 32)
InputLayer [(77, 800)]
Conv1D, ReLu (77, 16)
InputLayer [(88, 800)]
Conv1D, ReLu (88, 16)
InputLayer [(52)]
Global CNN
Regional CNN
Regional CNN
SoftMax
Feature Engineering
Input Global Region
Feature Engineering
Input Frontal Region
Feature Engineering
Input Oral Region
Feature Engineering
Input Orbital Region
Input Categorical and Scalar Values
Conv
Flatten
Dropout
Dense
Dense
Concatenate
Dense
Output
Concatenate, Relu (516)
Dense, Relu (32)
Dense, Softmax (6)

Driven by


approximate classification in given HB class [%]
100
90
80
70
60
50
40
30
20
10
0
HB1
HB2
HB3
HB6
50%
OLR
RF
GRU-tp100k
GRU-tp1.6M
CNN-tp160k
CNN-tp4M

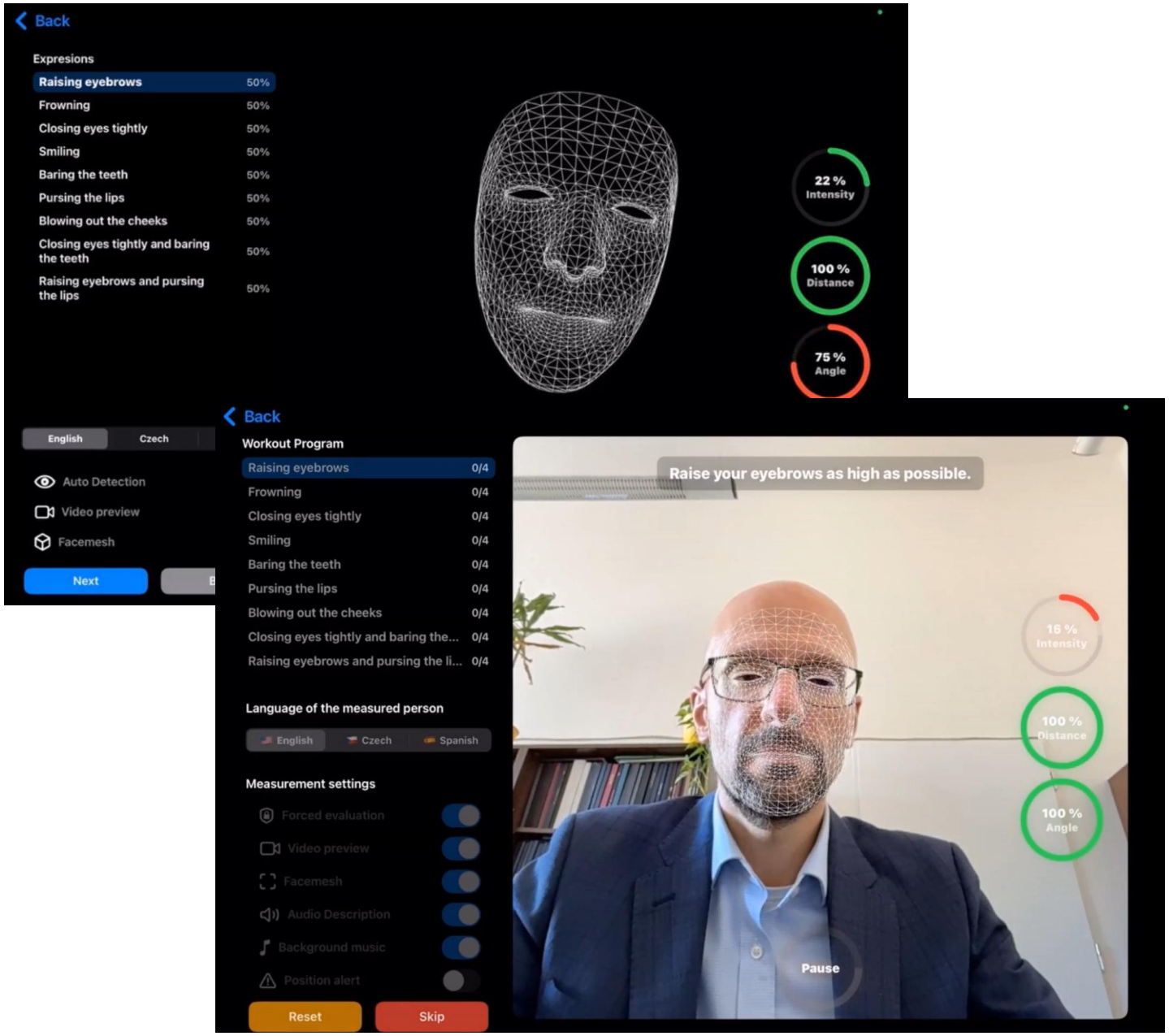

F1-Score %
80
60
40
20
0
HB1
HB2
HB3
HB4
HB5
HB6
TPCNN
CNN-LSTM
RESNET
LSTM
FCN

Our App

- **Multiplatform**
  - Web, PC,
  - Android, iOS

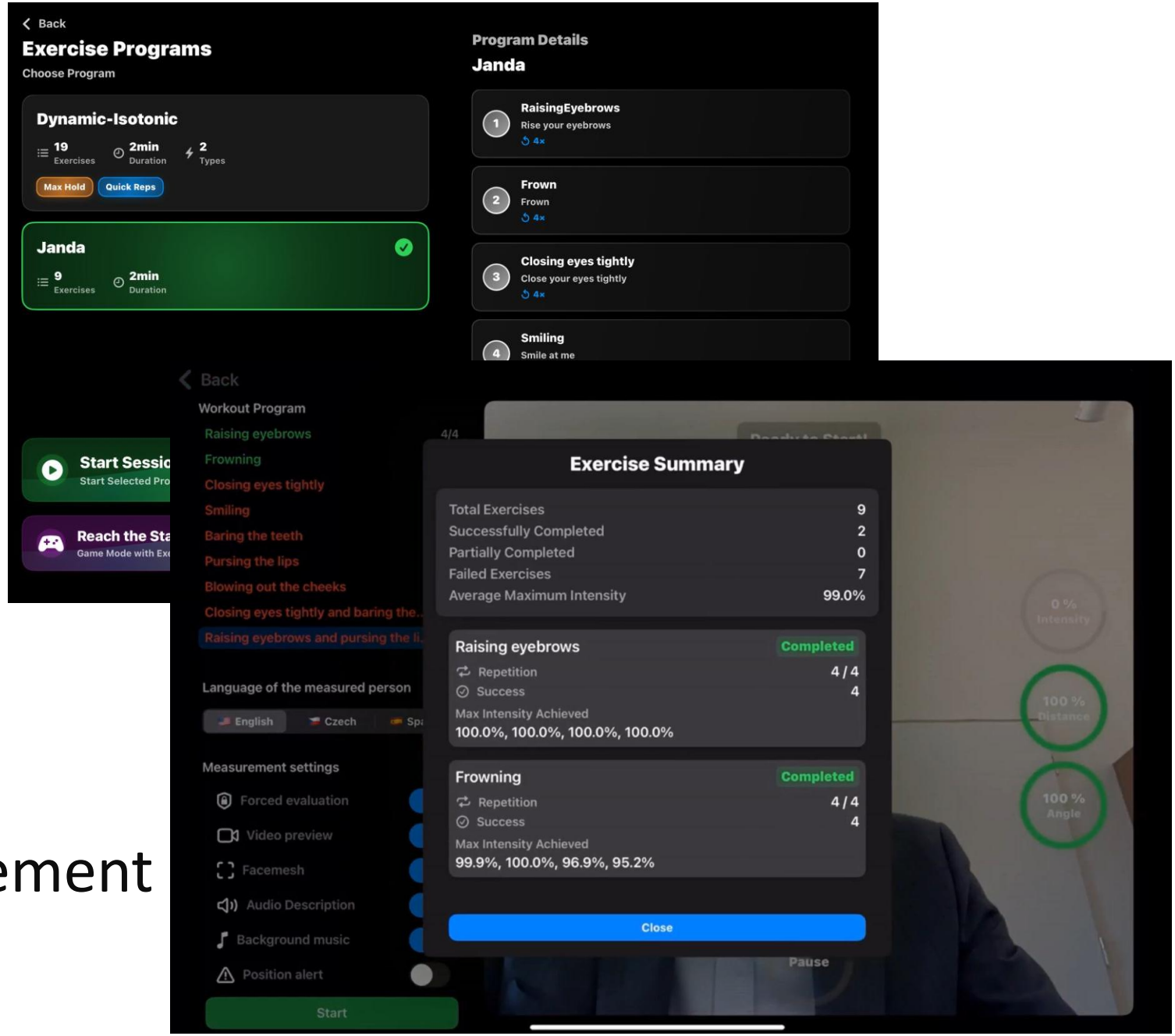
- **Face module**

1. **Personalized** calibration
2. **Automation** of exercises



Our App

3. Different **metodology**
4. Exercise **builder**
5. Various **neural network** models
6. **Game mode**
7. **Extensible** modules
   - Skeleton, Hand measurement



Our Vision

Clinicians

Accelerated examination

More efficient process

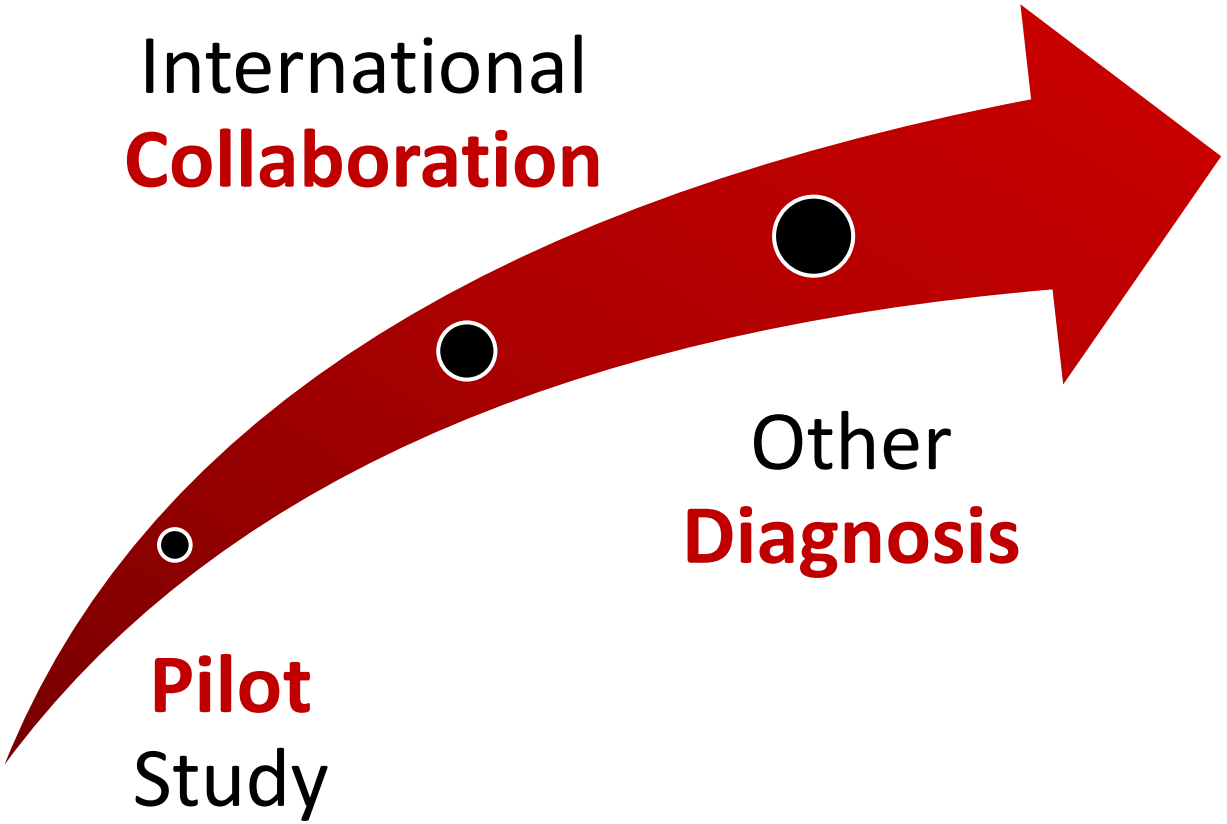
Objectivization of diagnostics

Patient

Dynamic monitoring

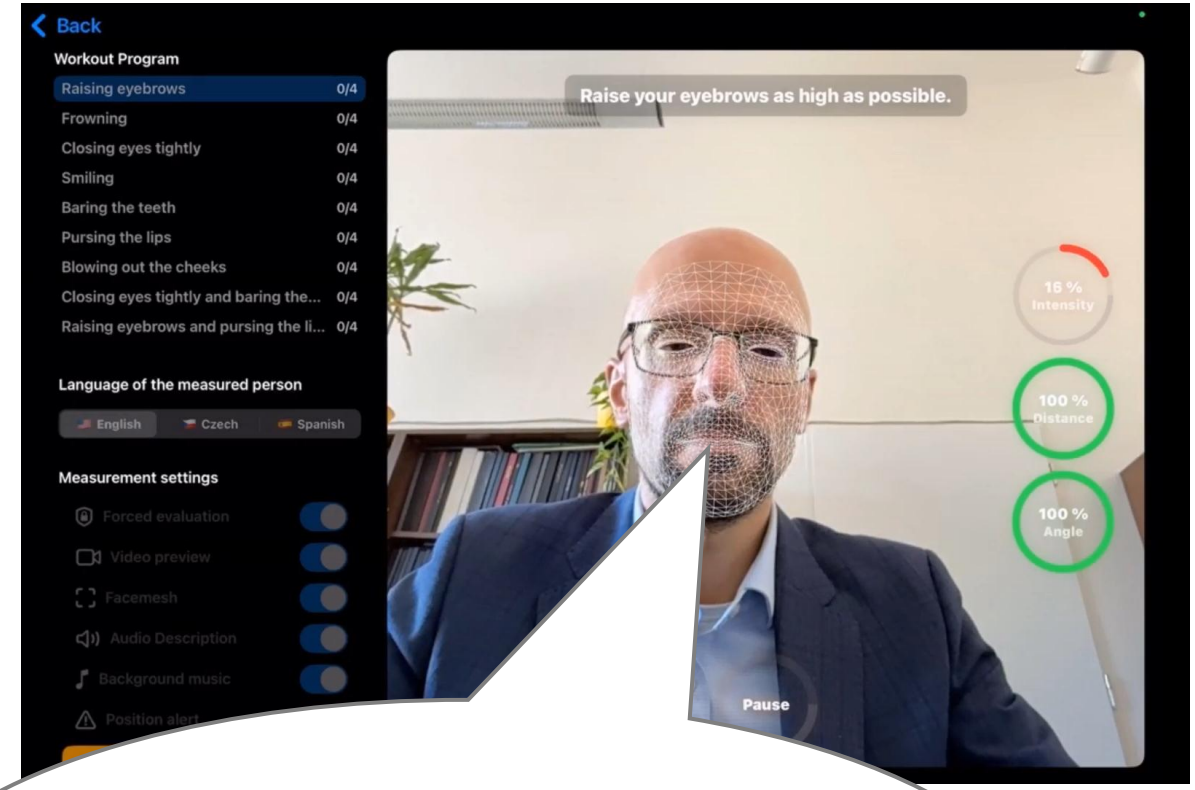
Prevention and motivation

Looking Ahead



Summary

1. **Automatization** for facial data acquisition
2. **Modular** system with various neural network models for classification
3. **Extensible** to more diagnostic modules
   - skeleton, hand, …



Open to **collaboration!**

Thank you.

We love helping people.