OST
Ostschweizer
Fachhochschule

ILT | Institute for Lab Automation and Mechatronics

Empowering Independence: Robot-Assisted Shopping for the Visually Impaired with Product Recognition

Chantal Keller

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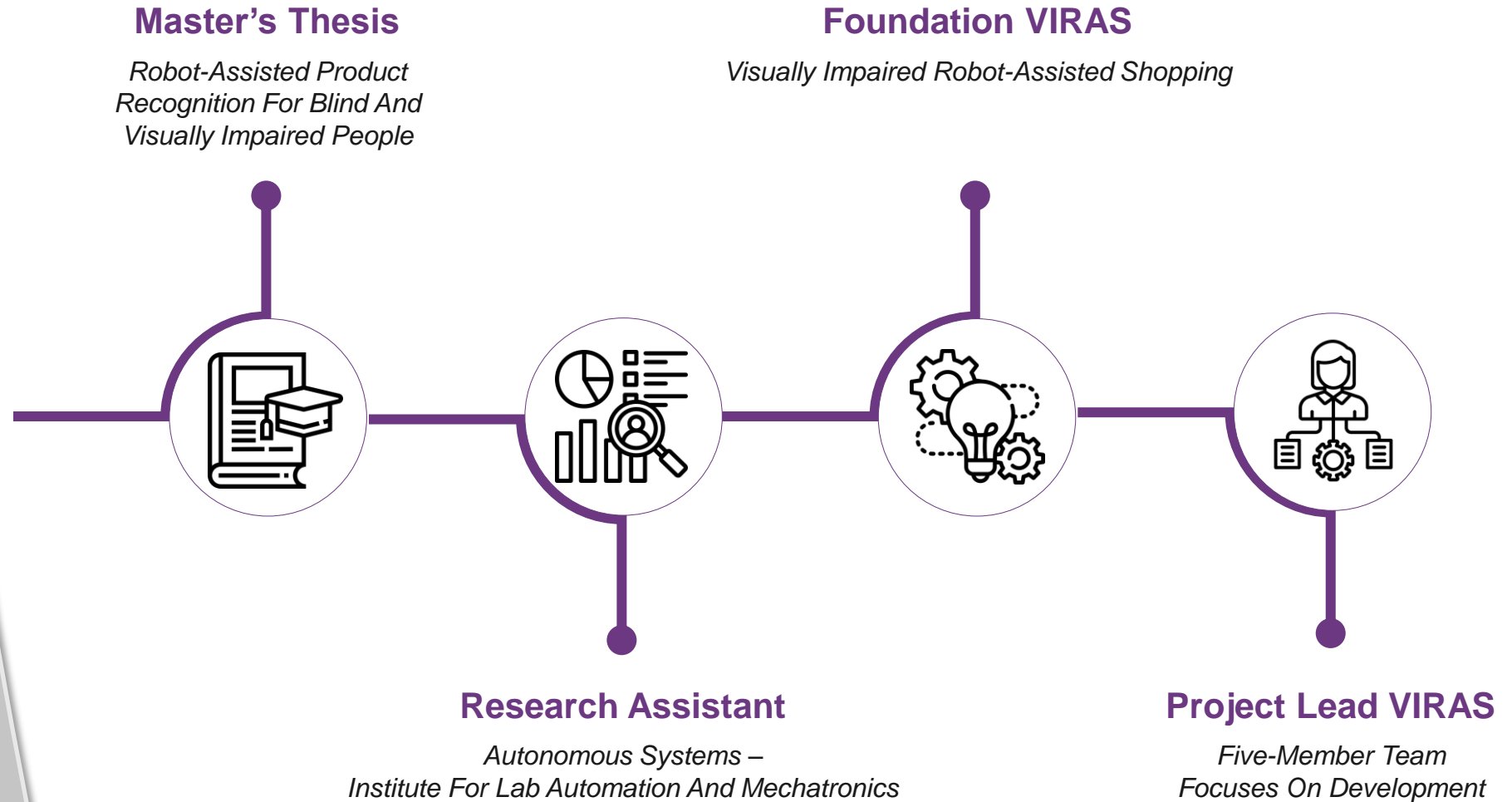Institute for Lab Automation and Mechatronics

ViRAS
Visually Impaired Robot-Assisted Shopping

Robot-Assisted Shopping for the Visually Impaired

Roadmap

Chantal Keller

MSc OST in Mechatronics and Automation

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Master's Thesis

Robot-Assisted Product Recognition For Blind And Visually Impaired People

Foundation VIRAS

Visually Impaired Robot-Assisted Shopping

Research Assistant

Autonomous Systems – Institute For Lab Automation And Mechatronics

Project Lead VIRAS

Five-Member Team Focuses On Development

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Robot-Assisted Shopping for the Visually Impaired

Inclusion
4% of the Swiss population is visually impaired
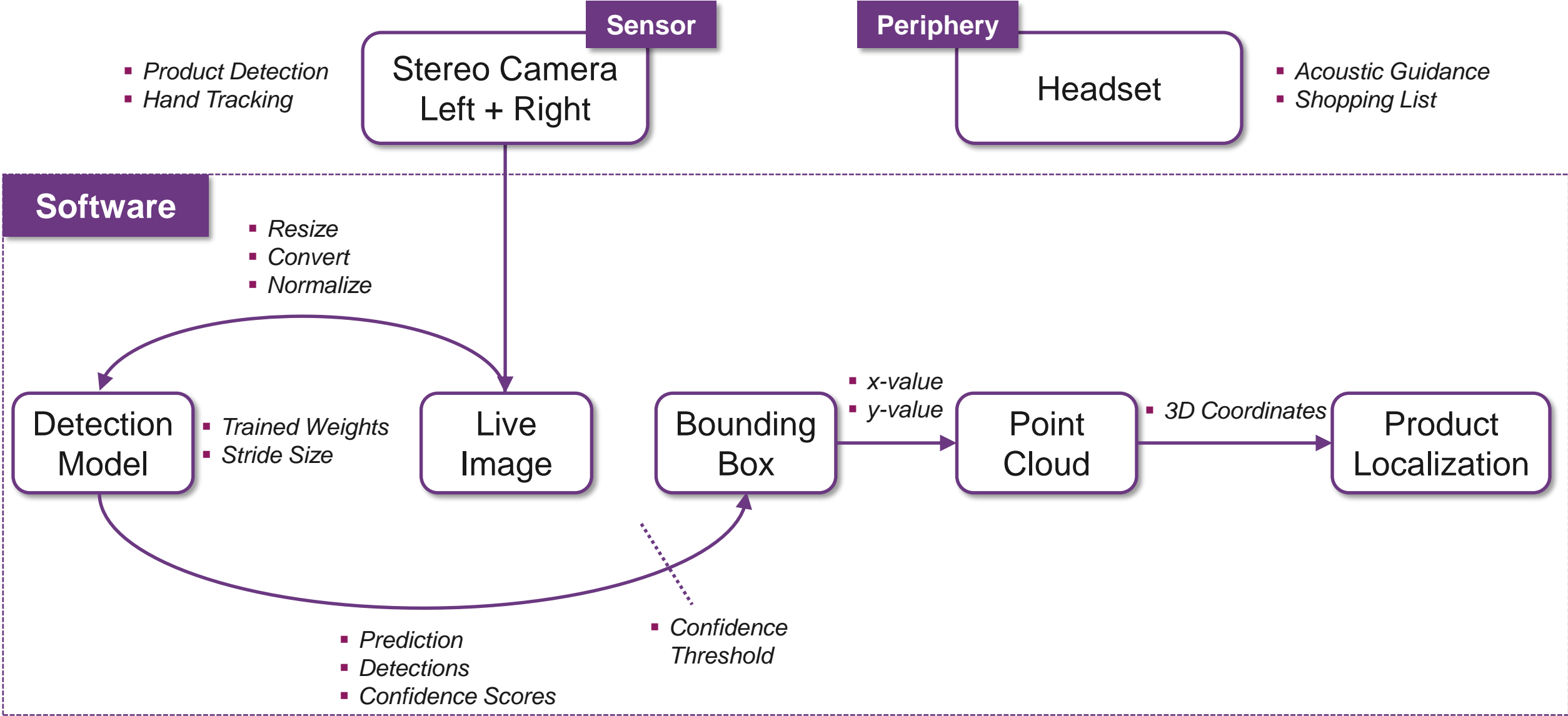
Challenges
Orientation and finding products

Acceptance
90% use of the shopping cart

Technology
Self-driving shopping cart
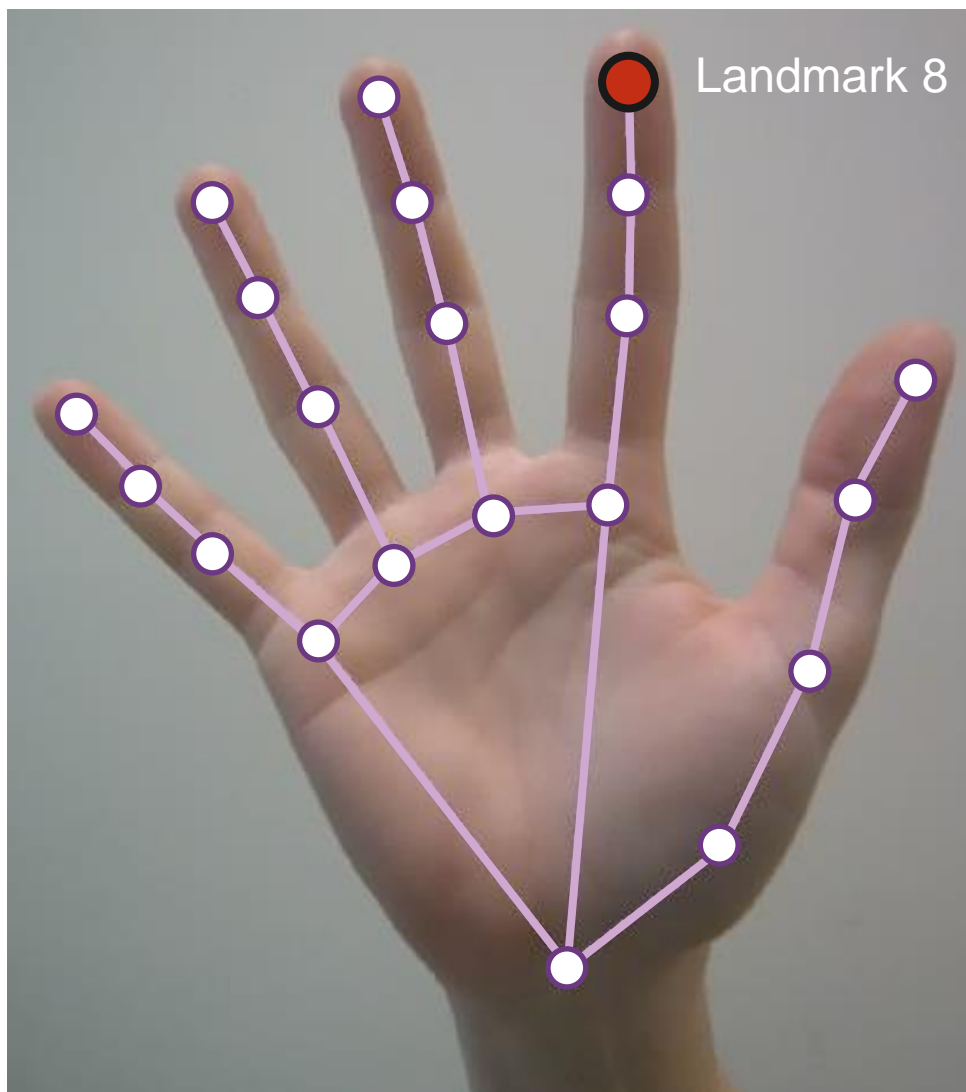with product and hand recognition

*VIRAS gives visually impaired people the **freedom** to shop **independently** and **autonomously**.*

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Robot-Assisted Shopping for the Visually Impaired

Sensor

Stereo Camera
Left + Right

- *Product Detection*
- *Hand Tracking*

Periphery

Headset

- *Acoustic Guidance*
- *Shopping List*

Software

- *Resize*
- *Convert*
- *Normalize*

Detection
Model

- *Trained Weights*
- *Stride Size*

Live
Image

Bounding
Box

- *x-value*
- *y-value*

Point
Cloud

- *3D Coordinates*

Product
Localization

- *Confidence
  Threshold*

- *Prediction*
- *Detections*
- *Confidence Scores*

MediaPipe

Hand Landmarks
Detection

21 Hand-Knuckle
Coordinates

> 30K Real-World
Training Images

Tip Of Index Finger

Landmark 8

$ pip install mediapipe

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Robot-Assisted Shopping for the Visually Impaired

Sensor: Stereo Camera Left + Right

Periphery: Headset

Software

- *Navigation Instructions*
- *Iteration*
- *User's Hand*
- *x-value*
- *y-value*
- *3D Coordinates*

Live Image → 21 Hand Points → Point Cloud → Spatial Distance

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eSpeak NG

Text-To-Speech

Speech Synthesizer

Target Group
German-Speaking
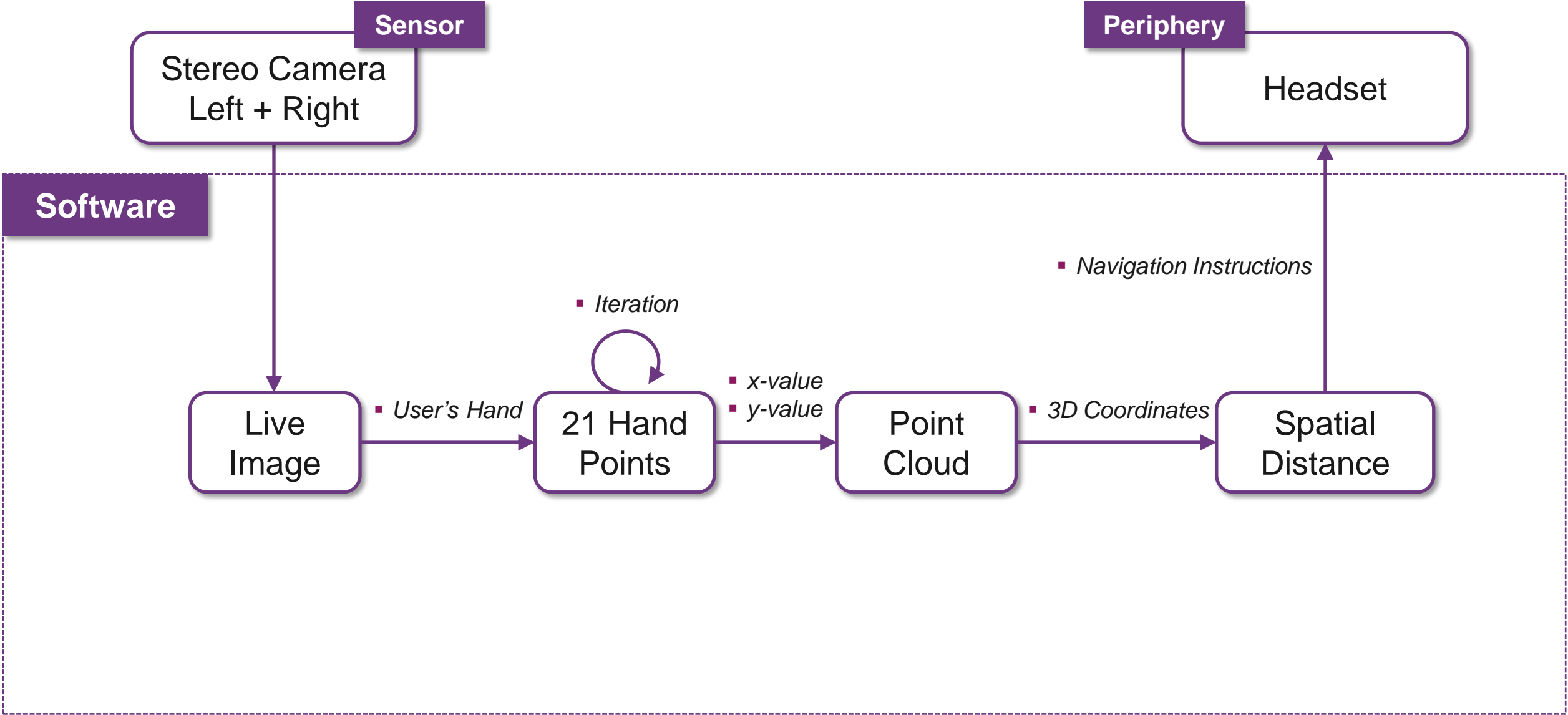
`$ pip install espeakng`

`$ pip install playsound`

Requirements	eSpeak	MP3
Open-Source	✓	✓
Offline-Available	✓	✓
German	✓	✓
Small Memory Usage	✓	✓
Natural Speech	✗	✓
Flexible Text Generation	✓	✗

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$ pip install speechcatcher

Speechcatcher

Speech-To-Text

Speech Recognizer

Target Group
German-Speaking

Requirements	Speechcatcher	Whisper
German	✓	✓
Offline-Available	✓	✓
Real-Time	✓	✓
Small Memory Usage	✓	✗

▪ *Trained Using Whisper As Teacher*

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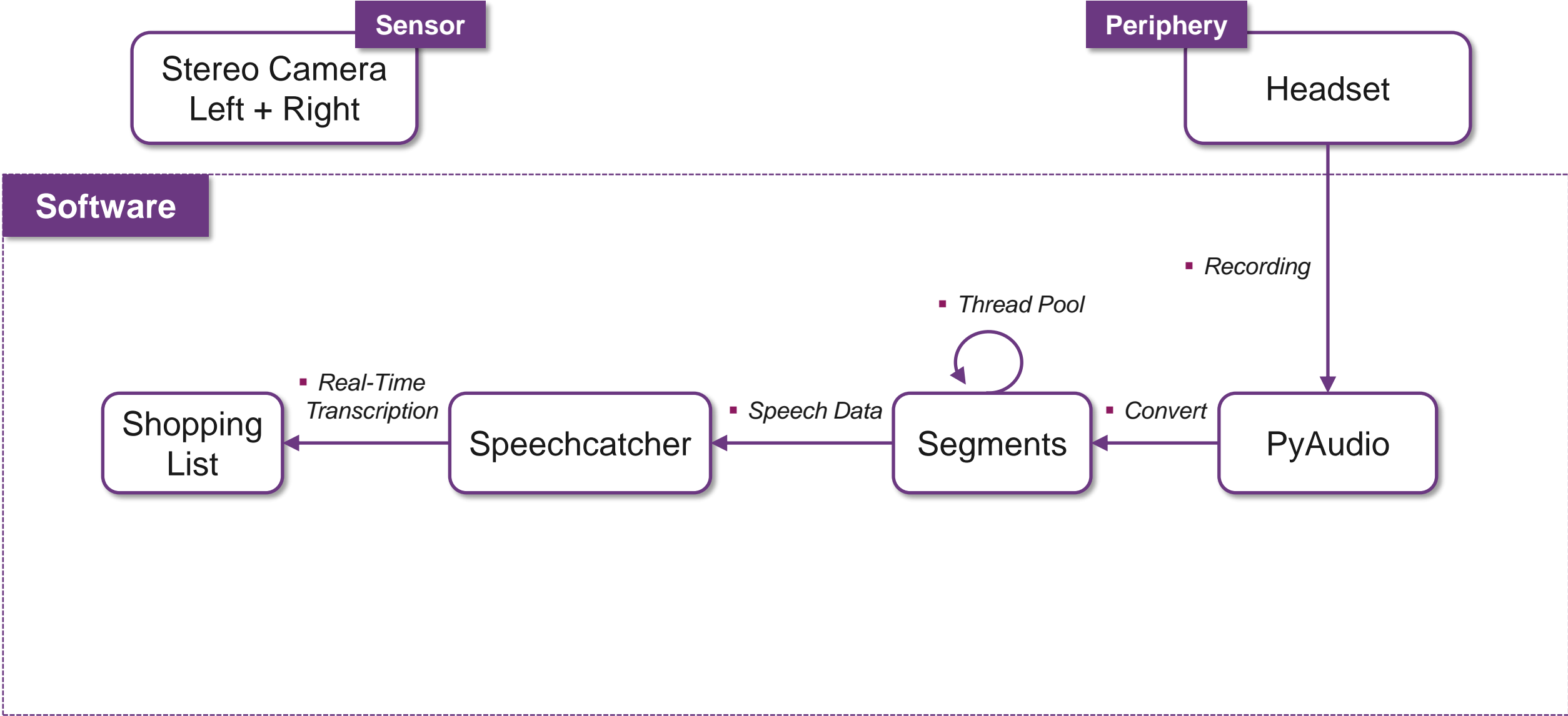
VIRAS

Product Identification
Hand Tracking
Mapping
Obstacle Avoidance
Navigation
Voice Input
Voice Output
Drive Unit

→ **Python**

User Interface

Stereo Camera

Stereo Camera

AI Computer

LIDAR

Motorization
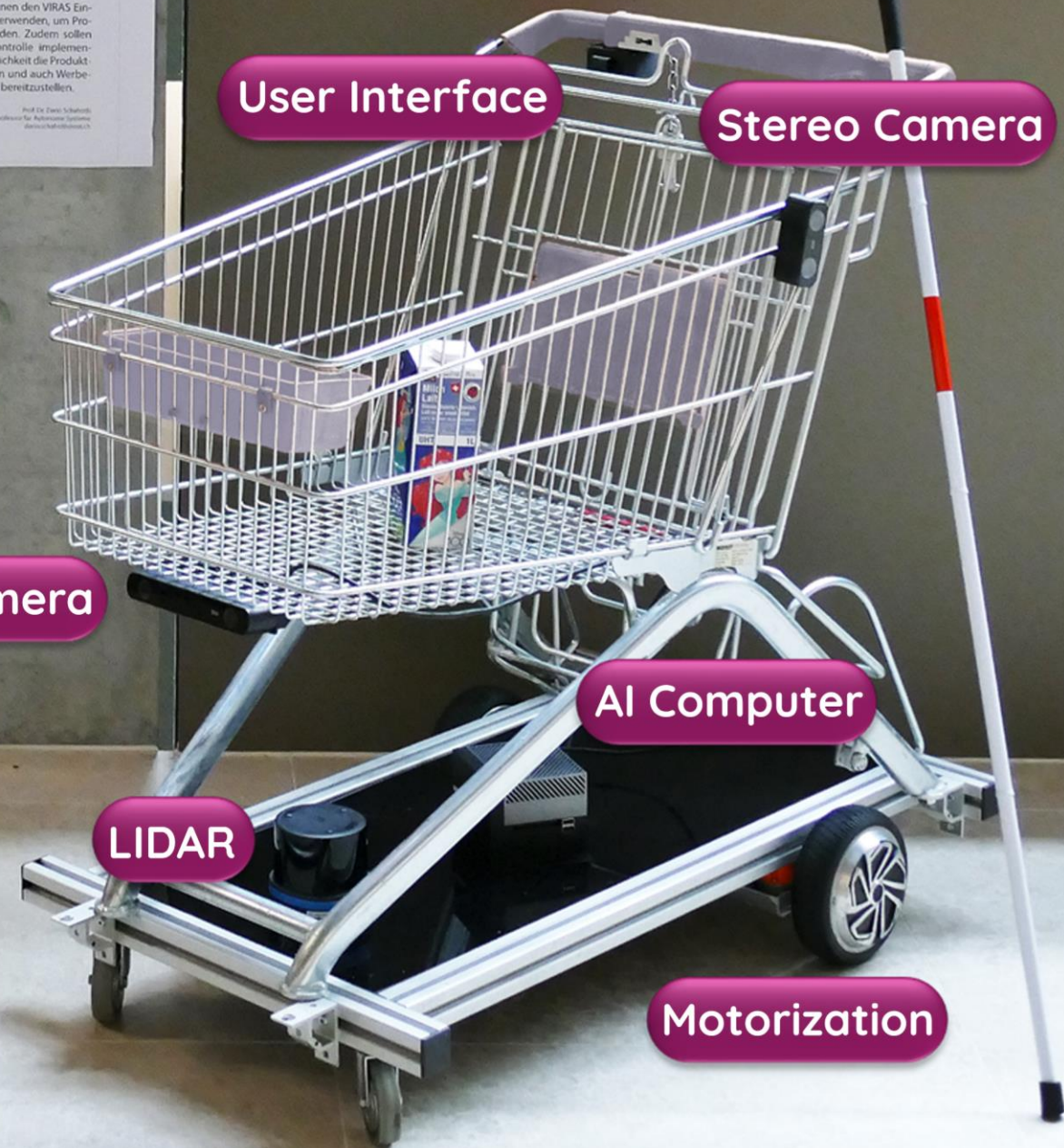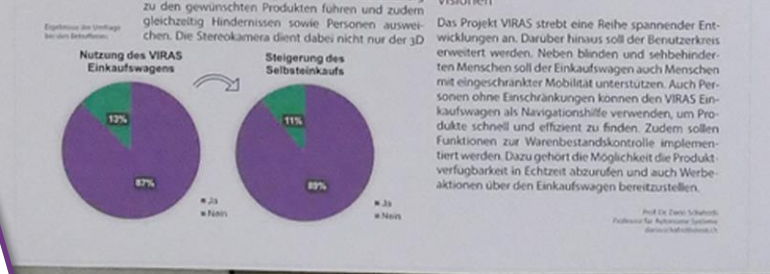
Barrier-Free

Efficent

Independent

You cannot help men permanently by doing for them what

they could and should do for themselves.