
# Enabling Video Privacy Through Embedded Vision

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# Presentation Overview

- Problems in long term care
- Live demo of solution
- What is difficult in getting this to work:
  - Computer vision problems
  - Infrastructure problems (focus of this presentation)
- How the technology works
- Clinical validation outcome
- Background of the Kepler Vision company
- Summary

# Problems in Long Term Care

## Issues

- Aging population:
  - Diminishing ‘supply’ of care (25% of caregivers to retire in next 5 years)
  - Increasing demand for care (6% growth YoY)
- Hardly any innovation:
  - Motion sensors generating too many alarms
  - Caregivers check on patients just like they did 100 years ago

## Resulting in

- Alarm fatigue
- Overstretched caregivers
- Patients not getting the care they need: 5 out of 6 patients remain on floor longer than 5 min when fallen
- Lack of privacy for patients: Three times at night a nurse enters room unnecessarily

# Live demo of solution

# Computer-Vision Specific Problems in Long Term Care

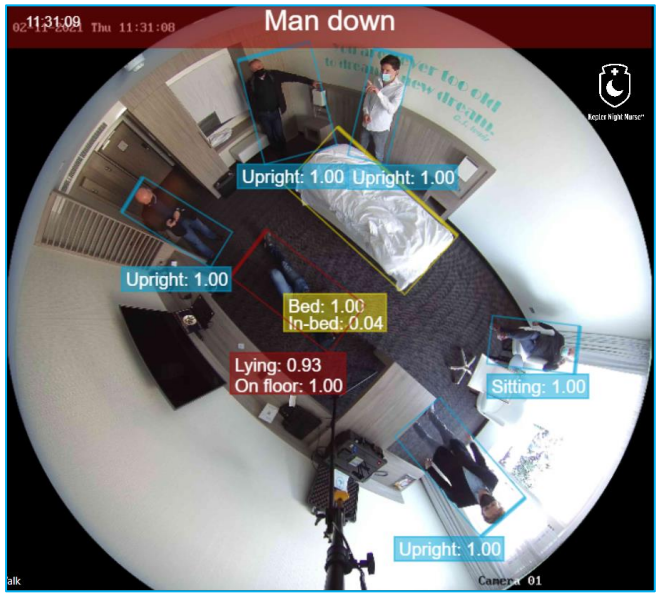
- High pixel resolution required to detect residents falling at end of hallway
- **Is deep learning the right technology?** No publicly available training datasets for
  - Infrared images
  - Human poses observed indoors as sitting, bending, lying, kneeling, crouching
  - Rare events such as falling
  - Fisheye images (see also next slide)

# The Kepler Night Nurse – Unique Fisheye Approach

2021 embedded VISION summit

## Conventional Camera

## Kepler Night Nurse Fish Eye Camera




- For humans, fisheye images are hard to interpret due to lens distortion and the strange viewing angle. This is not an issue for KNN
- Proprietary annotation studio able to label fisheye images
- Unwarping unnecessary, therefore image distortion is prevented and better recognition accuracy is achieved
- Unique AI solution to detect human behaviour from fish eye images
- Recognizes a person standing upright even while the image shows the person upside down
- Avoids blind spots which conventional cameras cannot

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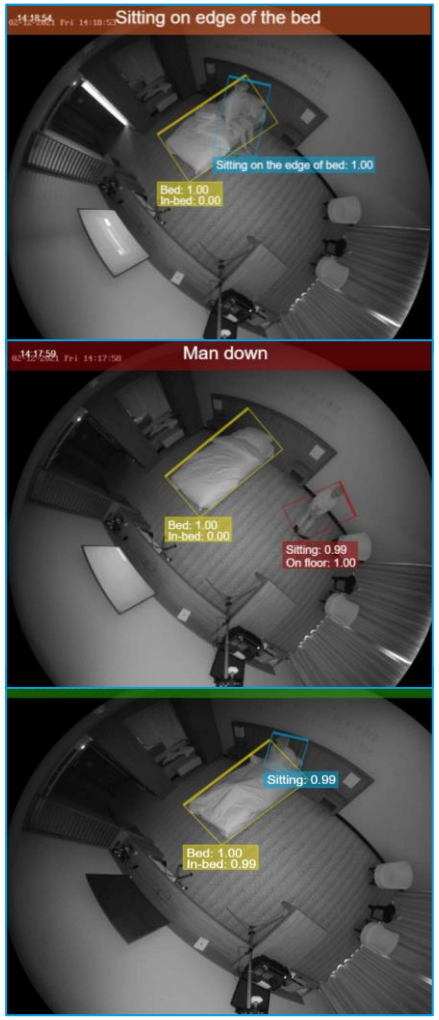
# Infrastructure and Hardware Specific Problems in Long Term Care (Focus of This Presentation)

- Low tech environment: No rack space available on premise
- Processing in the cloud is challenging:
  - Network maintenance outsourced, setting up VPN connection takes months
  - Internet bandwidth costly, setting it up takes months
  - AWS does not charge for incoming traffic but charges for data transfer between availability zones
  - **Perceived by non-technical stakeholders as insecure**

# The Kepler Night Nurse – How it Works




Edge Box (Located safely on site)

Nvidia Jetson GPU

Processes eight 12MP video streams simultaneously

Helicopter surround view camera position

Fisheye video option A

Fisheye video option B over VPN

Encrypted metadata over HTTPS

Encrypted text message

Amazon data center in Frankfurt

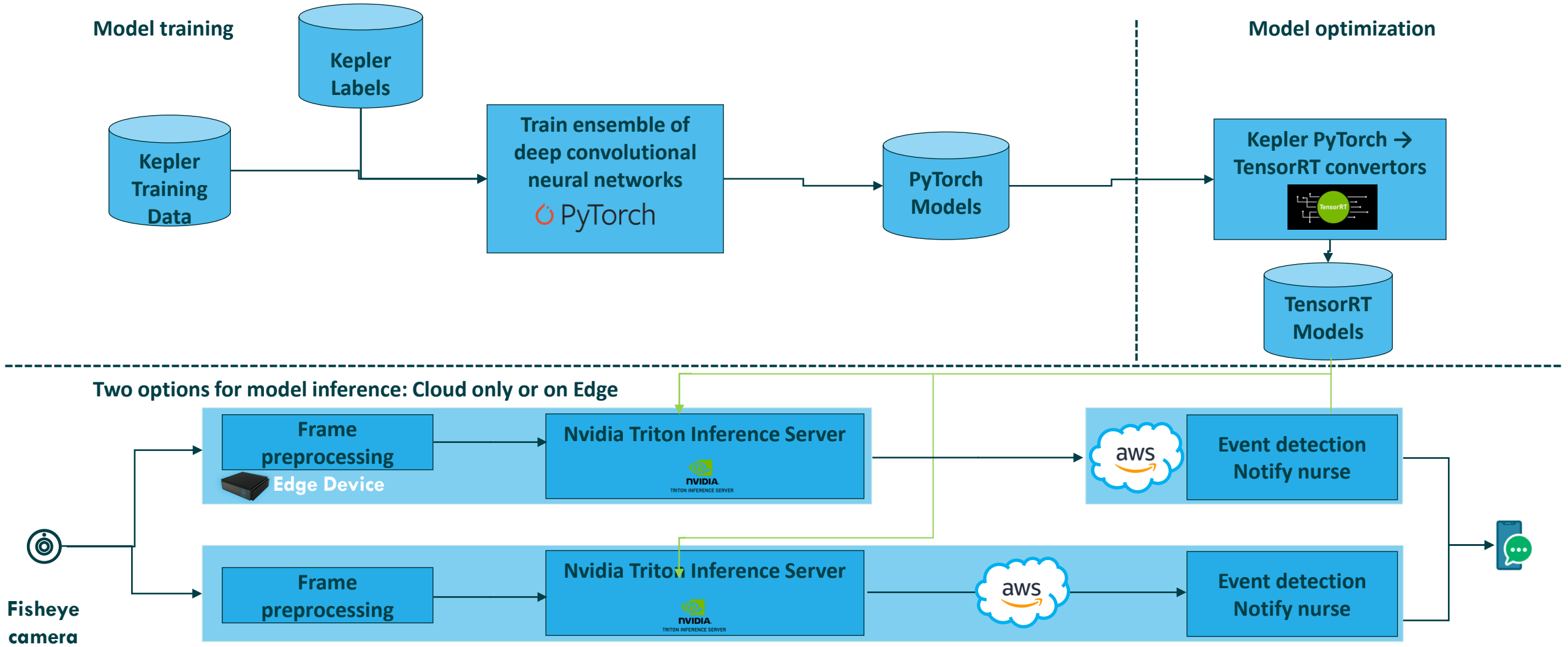
1 Monitor

2 Process

3 Understand/Assess

4 Alert

# Deep Learning Model Training and Inference



# Clinical Validation Outcomes

- Over 99% reliability
- 1 false alarm per video stream per 96 days
- Assistance takes more than 5 minutes to arrive after fall
  - Without the Kepler Night Nurse: 6 out of 7 cases
  - With Kepler Night Nurse: 1 out of 7 cases

# Introduction to Kepler Vision Technologies

## Company Overview

- Founded in 2018
- Founded by a team of PhDs in computer vision with over 20 years of experience
- Spin-off from the Faculty of Science of the University of Amsterdam
- Headquarters in Amsterdam, the Netherlands
- 15 employees (11 FTE), of which 7 PhD's

## Best in Class

- Source code quality rated by TÜV 4 out of 5-star two years in a row
- 3 patent families granted, and 11 patent families pending related to AI and computer vision
- Kepler Night Nurse (flagship product) is registered as a medical device in Europe
- Certified ISO 27001 and NEN 7510, to securely process personal and medical data

## Selected Awards

- Microsoft Innovate AI Challenge Global Top 10 2018
- Future of AI Innovate AI Competition First Prize Winner Europe 2019
- The Big Score Top 50 Most Promising European Scale-up 2019
- GIANT Health Event Winner Scale-up Competition 2020

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# Summary: How embedded vision enables video privacy in long-term care

| Challenges due to cloud-based vision solution | Advantages of embedded vision solution |
|---|---|
| Low tech environment, no rack space available on premise | Embedded vision on edge box does not need rack space |
| For security reasons, we connect from the cloud to the camera over VPN (outside in).<br>However, setting up VPN connection takes months | Edge box connects to cloud (inside out) over HTTPS/TLS connection<br>Video stays on premise, only metadata needs to be encrypted |
| Bandwidth costly to connect to cloud<br>(32 Mbit/s per 8 video streams of 6 MP) | Embedded vision on edge box outputs only fraction of data (1 Mbit/s per 8 video streams |
| Cloud perceived by non-technical stakeholders as privacy issue | Video does not leave premise when using edge box |

Cloud-based or embedded:

Staff is alerted *only* when resident is in acute need, thus no unnecessary visits three times at night


# Raising venture capital to expand to the UK

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