Real-Time Detection of unsafe forklift behavior in the warehouse based on Deep Learning and Pose Estimation

Kanazawa Institute of Technology

Contents

This research will focus on forklifts operating and moving within the warehouse. To help forklift operators prevent an accident caused by unsafe behavior and provide better instruction following Hiyari Hatto.

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Background information

Sang-ngenchai Apirak

サンゲンチャイ アピラク

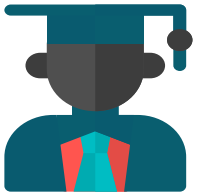
Advisor Preference

Professor Nakazawa Minoru

中沢　実

https://researchmap.jp/read0051201

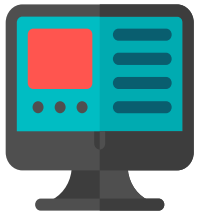
Education and Work timeline



2013 - 2018

Bachelor's degree

Rajamangala University of Technology, Chiang mai



2018 - 2020

Research and development

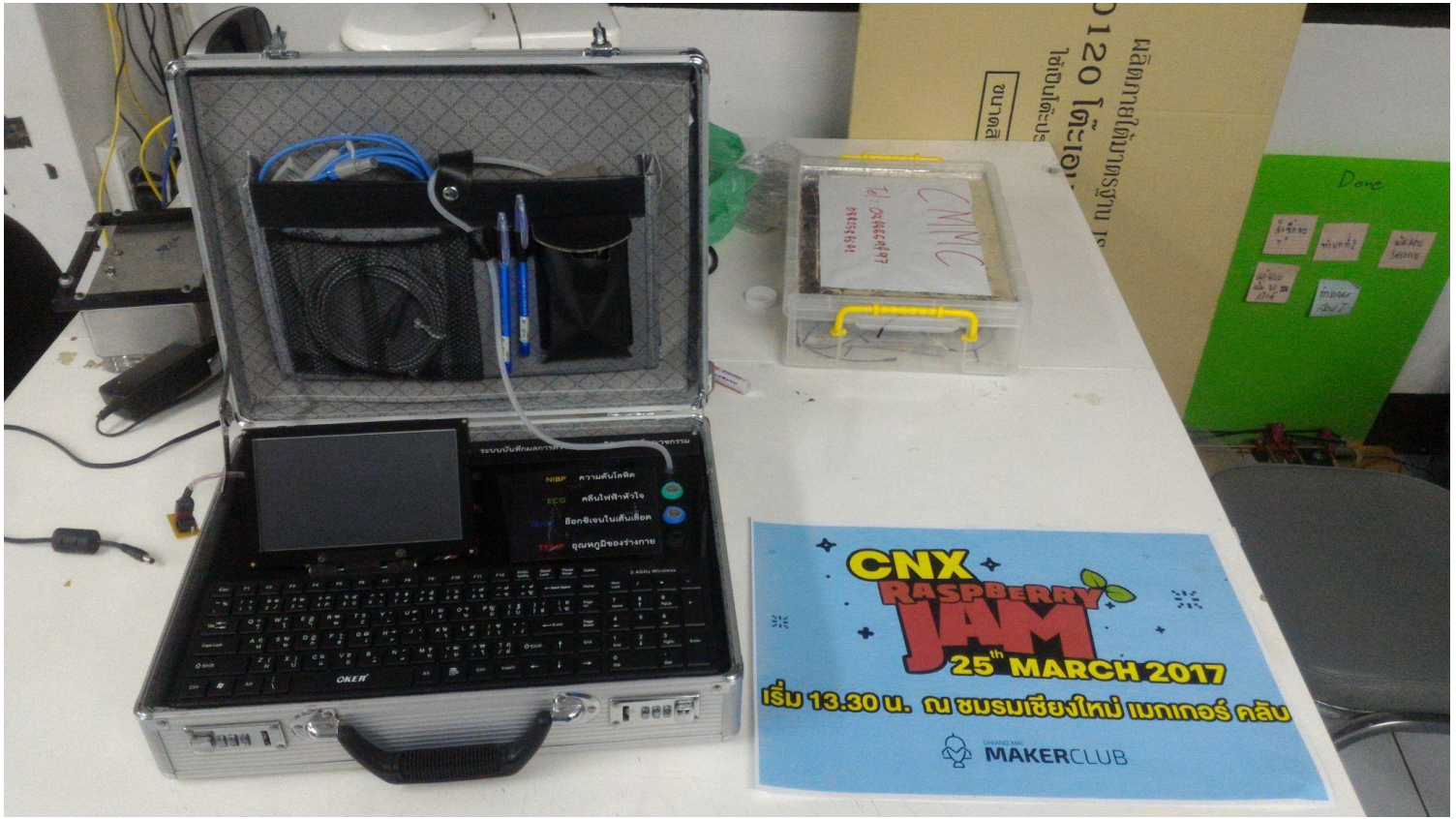
Maker Asia Co.,Ltd.

2020 - 202x

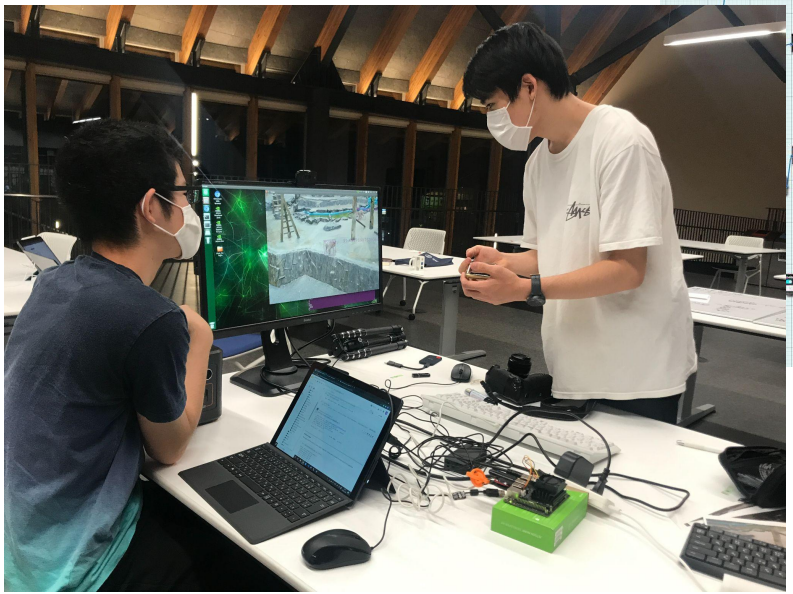
Learning Mentor

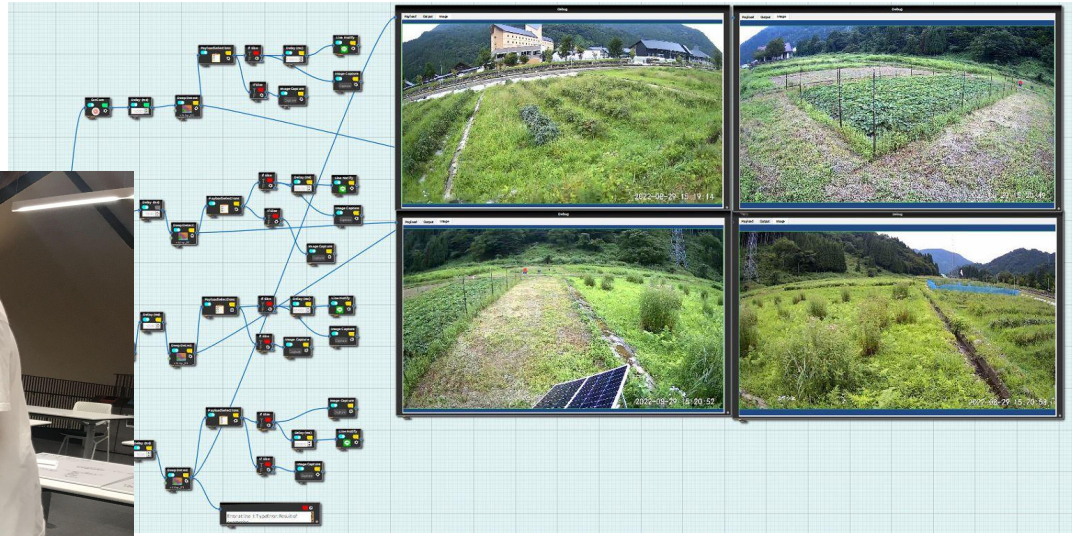
International College of Technology, Kanazawa

RMUTL : Portable Multi-parameter for Telemedicine



ICT, Kanazawa : Animal Prevention System





i2Lab (Image and Implement)

https://minorunakazawa.github.io/i2lab/

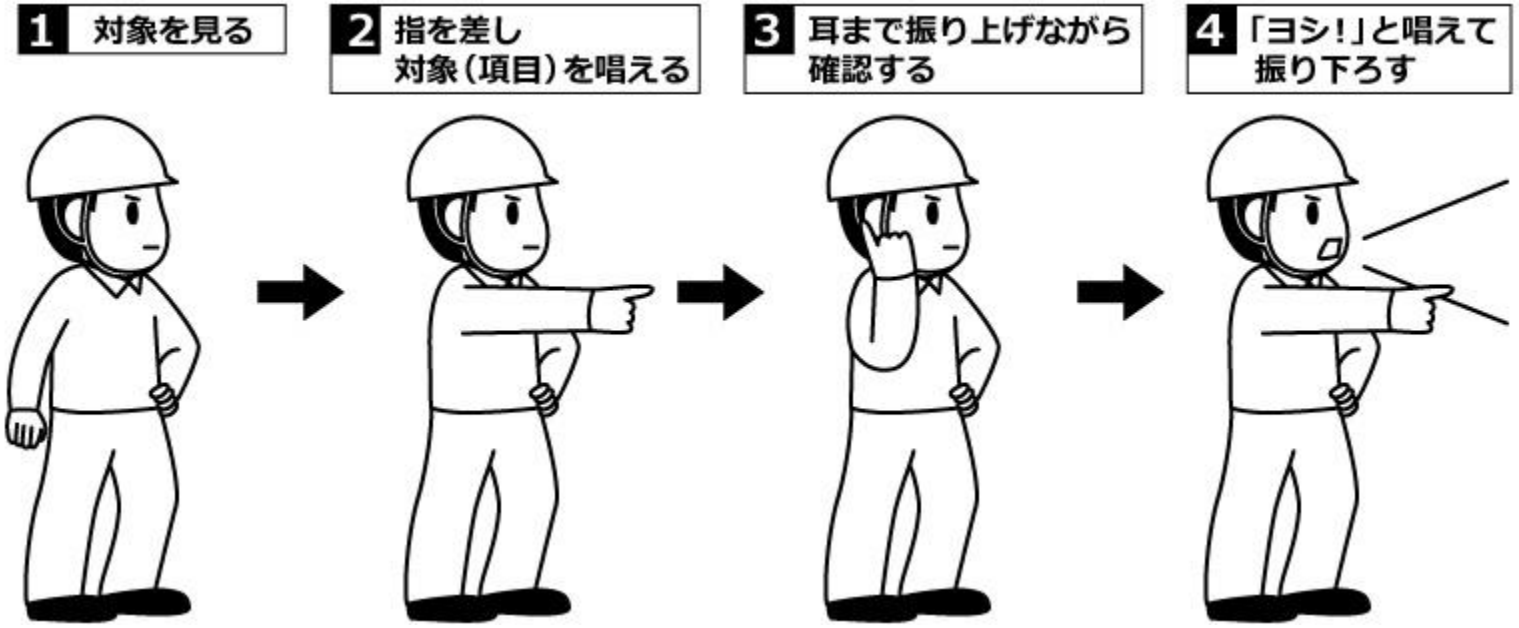
According to Japan International Center for Occupational Safety and Health (JICOSH), nearly 2,000 workers die annually in 2000s from industrial accidents.

https://www.jisha.or.jp/english/information/accident_cases.html

“The research needs to be able to identify unsafe behavior following Hiyari-Hatto”

Problem statement

Pointing and calling（指差喚呼ーしさかんこ）



https://www.tokubetu.or.jp/kyk/kyk05-2.html

Objective

- Ensure forklift operator follow the Hiyari Hatto protocol and make correct gestures and visual checks while working
- An application of identifying unsafe behavior of forklift operator
- Dataset and labeling of identifying Hiyari Hatto
- To help insurance companies access and further instruct on better safety measures

Literature Review

You Only Look Once, 2015

YOLO is extremely fast. They frame object as a regression problem to spatially separated bounding boxes and associated class probabilities

MediaPipe, 2019

A framework for building pipelines to perform inference over arbitrary sensory data

Mitsubishi Heavy Industries, 2019

Development of Automatic Human Detection System for Forklifts using Image Recognition Technology

MediaPipe Hand, 2020

Present a real-time on-device hand tracking solution

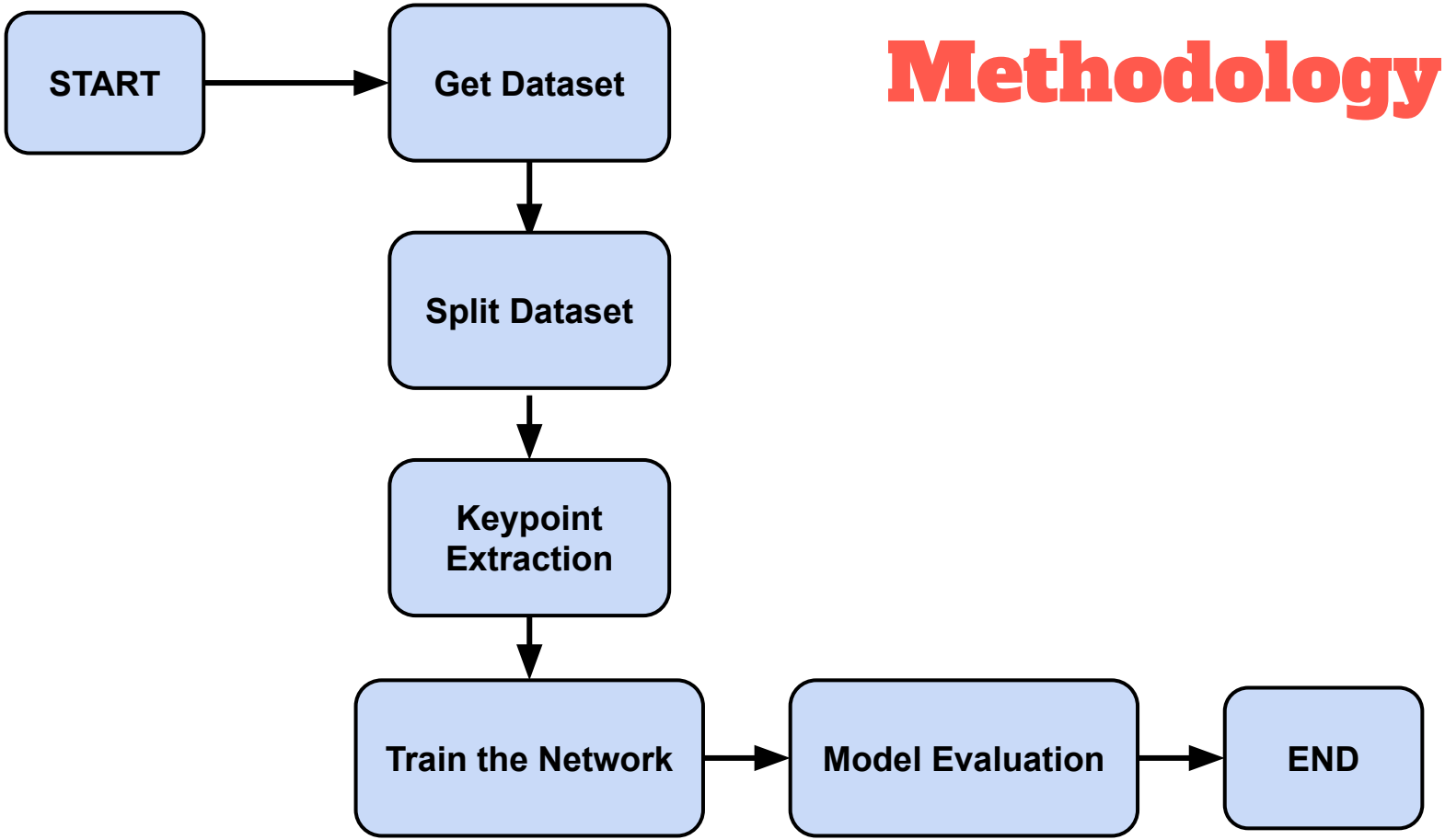
BlazePose, 2020

A lightweight convolutional neural network architecture for human pose estimation

Dimitris Chortarias, 2021

Human Activity Recognition with Deep Learning

Methodology

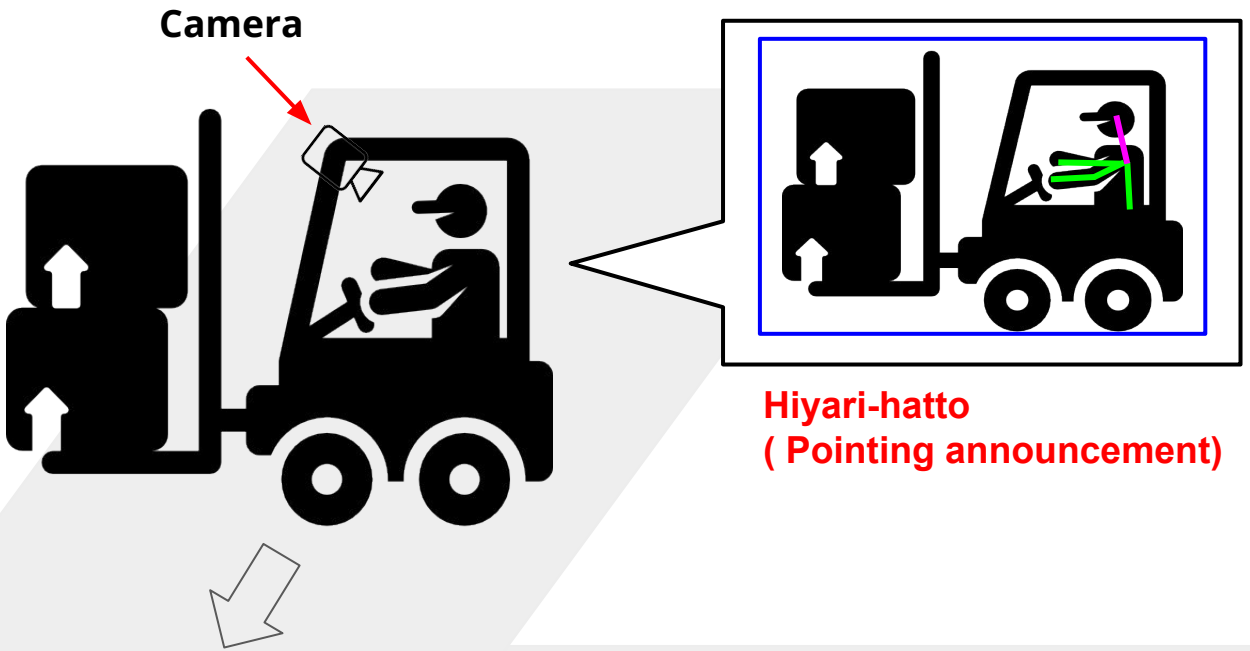


Methodology: Data Collection

- MPII Human Pose Dataset
- Penn Action Dataset
- Human3.6M Dataset
- Kaggle Forklift Image Dataset

- Forklift operator with Hiyari Hatto gesture (Pointing announcement)

https://videohive.net/item/front-view-forklift-operator-driving-in-large-industrial-warehouse-indoors/34070207



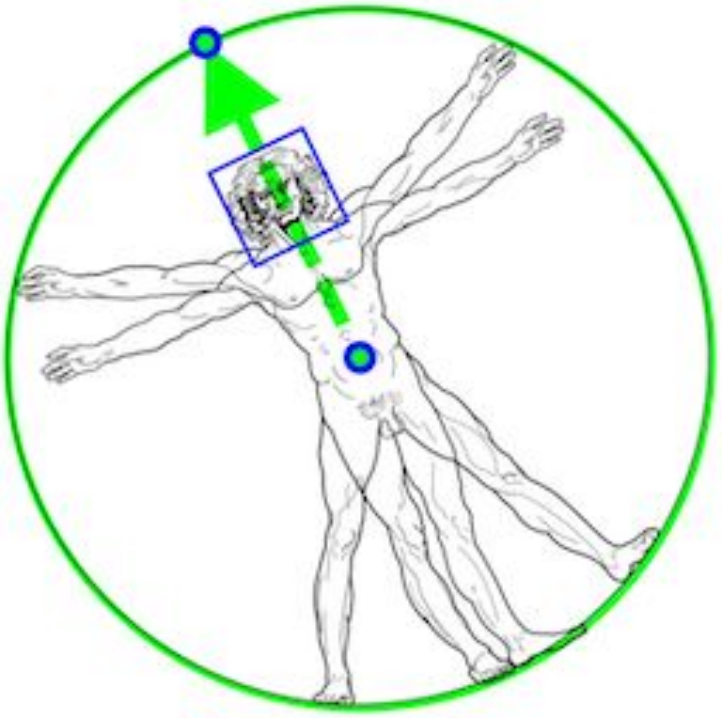
Hiyari-hatto
(Pointing announcement)

Dataset from Tokio Marine Nichido insurance

https://www.tokiomarine-nichido.co.jp/en/us/principles/symbol.html

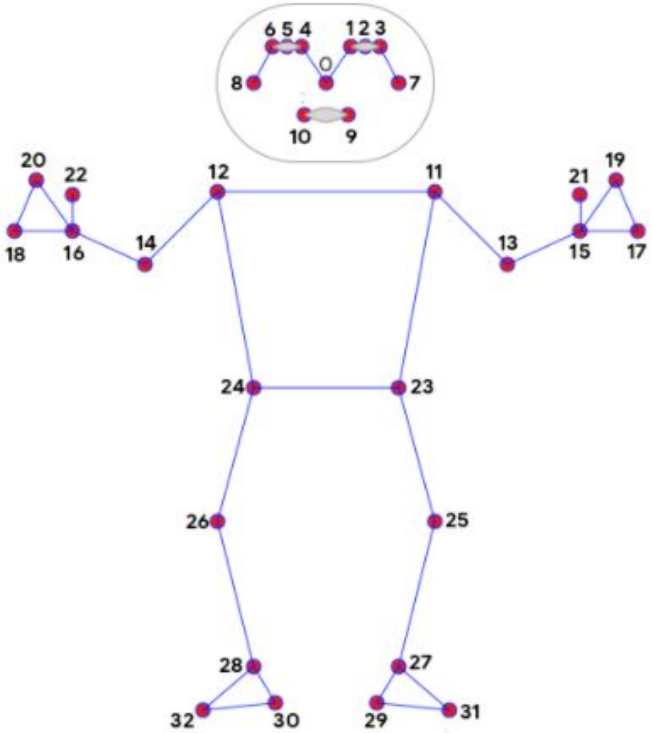
Methodology: MediaPipe

MediaPipe



https://google.github.io/mediapipe/solutions/pose.html

Methodology: BlazePose Detector



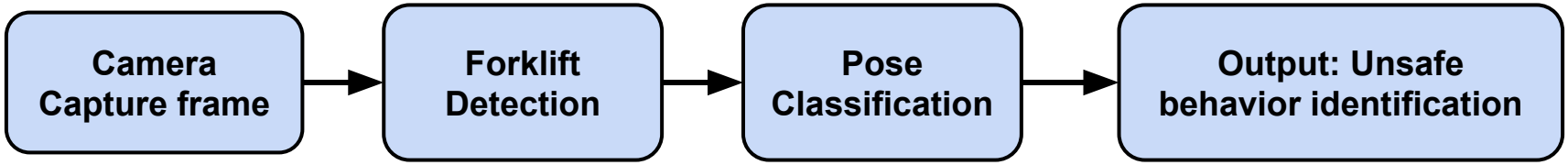
0. nose
1. left_eye_inner
2. left_eye
3. left_eye_outer
4. right_eye_inner
5. right_eye
6. right_eye_outer
7. left_ear
8. right_ear
9. mouth_left
10. mouth_right
11. left_shoulder
12. right_shoulder
13. left_elbow
14. right_elbow
15. left_wrist
16. right_wrist
17. left_pinky
18. right_pinky
19. left_index
20. right_index
21. left_thumb
22. right_thumb
23. left_hip
24. right_hip
25. left_knee
26. right_knee
27. left_ankle
28. right_ankle
29. left_heel
30. right_heel
31. left_foot_index
32. right_foot_index

https://google.github.io/mediapipe/solutions/pose.html

Methodology: Pose Recognition technique

- Calculate the angle between landmarks
- Build Deep Neural Network Models with keras
- Develop a Long Short-Term Memory network model (LSTM)

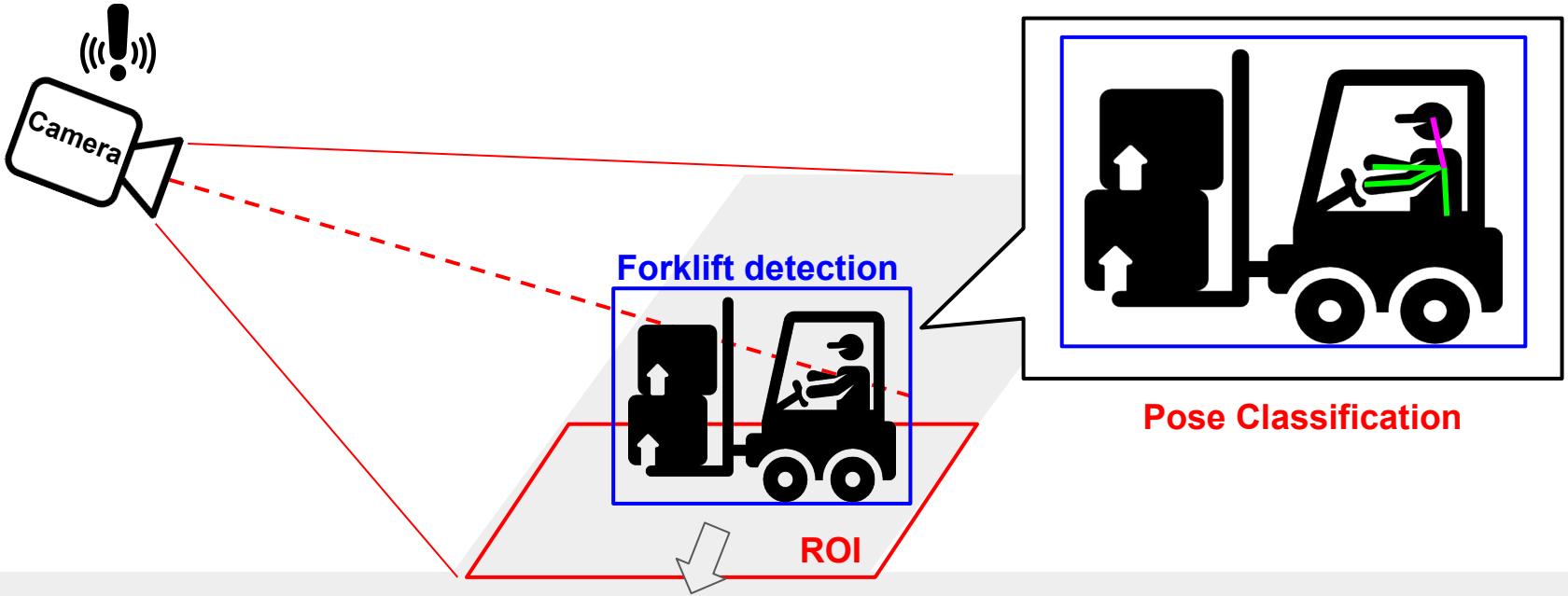
Methodology: Combining Models



Methodology: Experiment

- Off-Site experiment (evaluation on Test dataset)
- On-Site experiment (install a device on forklift)

Project Scenario



On-Site experiment

Expect Outcomes

- Identify the Human body joints
- Estimate unsafe behavior following the hiyari-hatto protocol
- Design a Neural Networks or Technique for Pose Classification
- Hiyari Hatto Pose Keypoint dataset
- Help an Insurance companies access and further instruct on better safety measures

https://www.youtube.com/watch?v=zDURMM0DYCM

Resolving trade-offs

- Might decrease the accuracy of pose estimation by the video distance and camera angle
- Might be difficult to estimate the hand pose estimation
- The research in human pose estimation is in vast
- None of the Hiyari Hatto Pose keypoint dataset

Bibliographical References

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Thank you for listening!

Do you have any questions?

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