

# Human Activity Monitoring for Mental Health Assessment

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# Overview

- Uses, Features, and Capabilities
- Technology and How It Works
- Specifications
- Further Development and Marketing Opportunities
- Demo

Uses, Features, and Capabilities

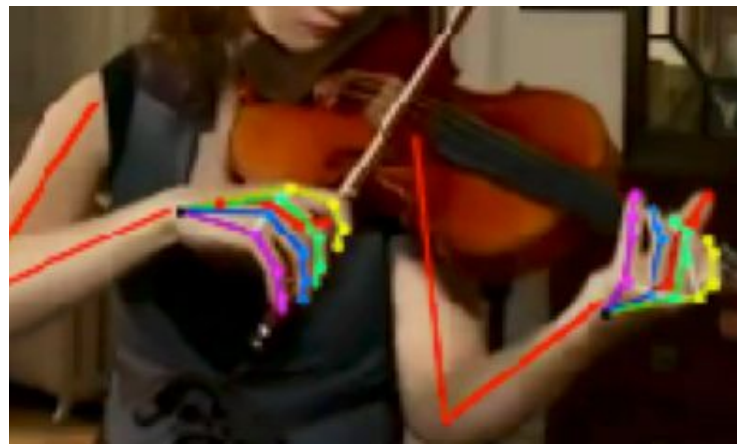
# Uses

- Versatile with uses for other applications
- Detection of multiple physical symptoms simultaneously
- Health and Fitness
  - Physical Therapy
  - Yoga
  - Fitness/sports training



# Uses

- Entertainment
  - Video games
  - Dancing
  - Music
- Surveillance
  - Crime investigation
  - Human monitoring
- Smart technology
  - Automobiles
  - Homes

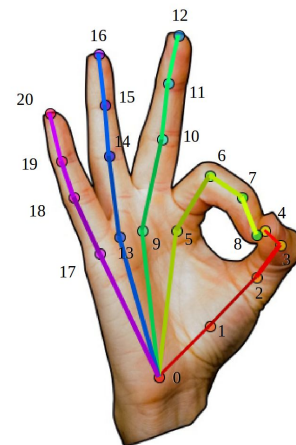
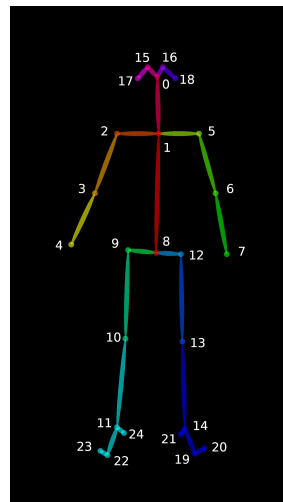
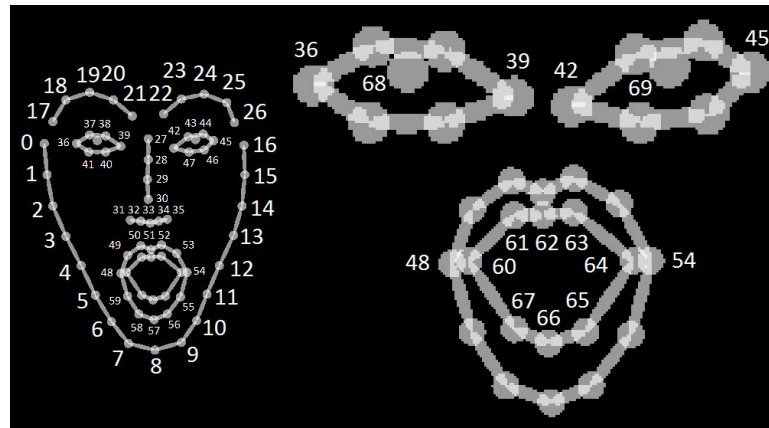


# Features

- Display of information onto the original video
  - Data related to hand flapping
  - Keypoints and vectors related representing body
  - Angles and Frequencies of repetitive motion
- Notification system
  - Angle threshold
  - Frequency threshold
  - Change of text
- Action Recognition
  - Display of recognized actions of patient

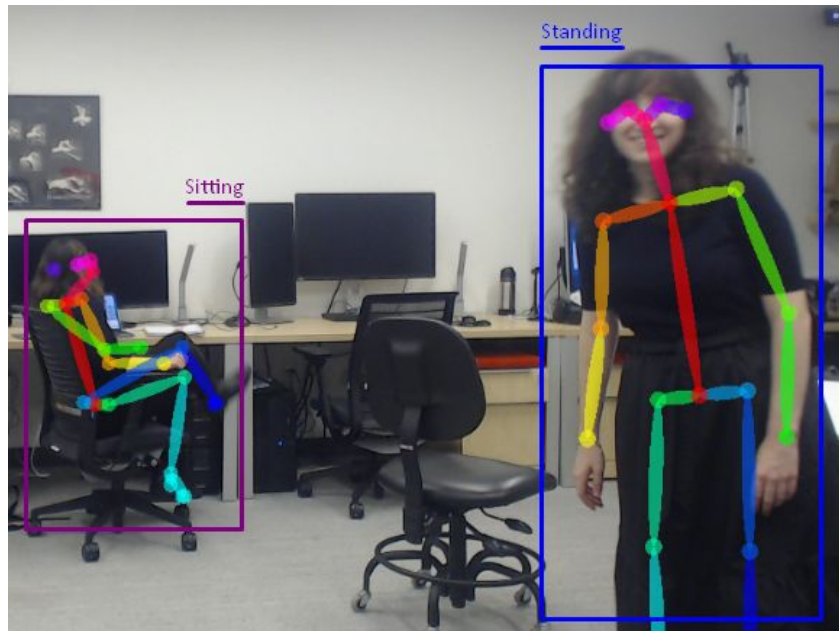
# Capabilities

- Keypoint vector options
  - Default: Background + keypoint vectors
  - Completely filtered background
  - Data only, no graphics
- 135 keypoints throughout the body
  - Ears, eyes, legs, big/small toes, heels, etc.
  - Advanced: facial features and hands



# Capabilities

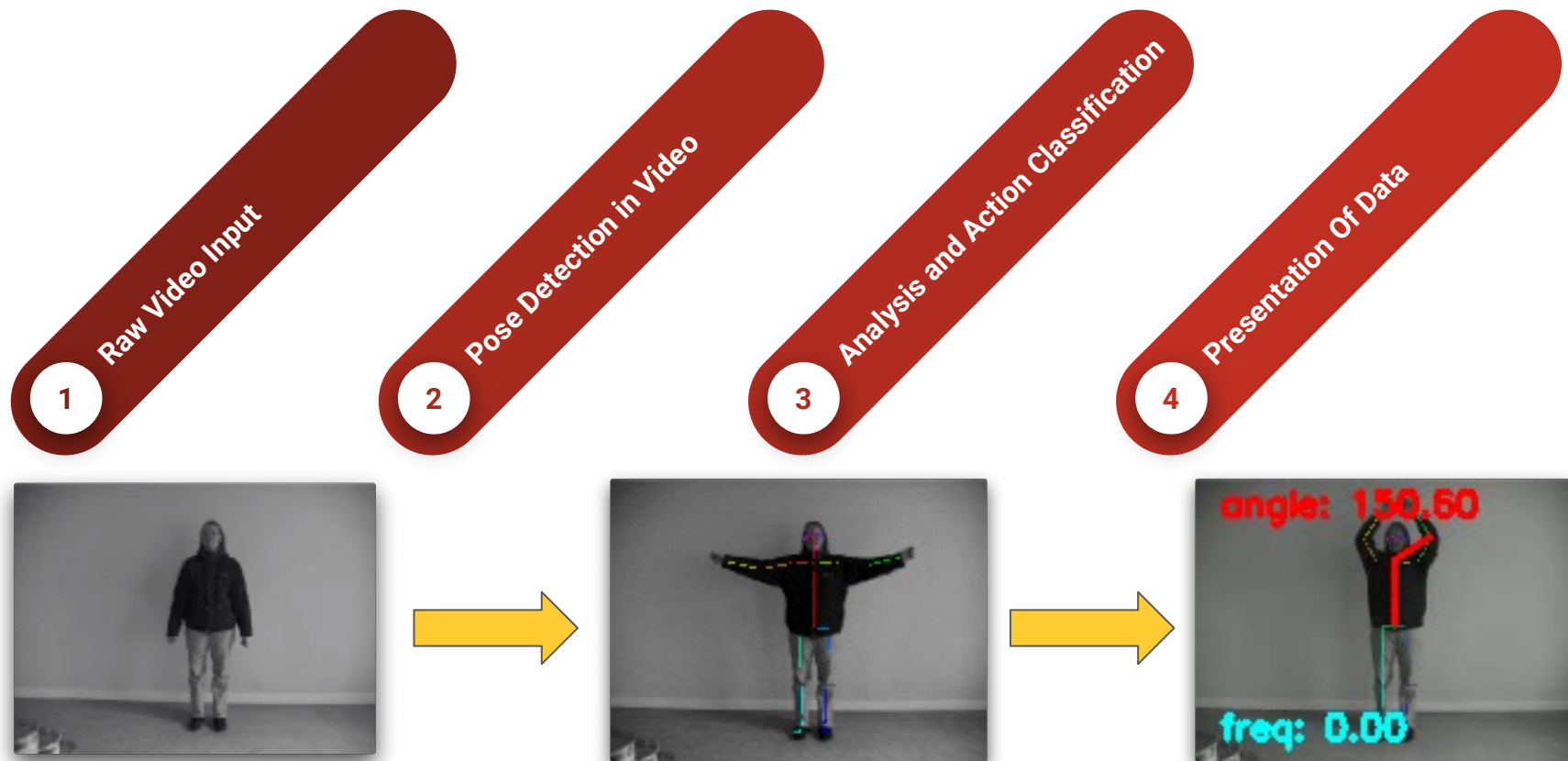
- Overlay/display
  - Any information desired by user
  - Shapes and text options
  - Changeable notification system
- Action Recognition
- Multi-person tracking





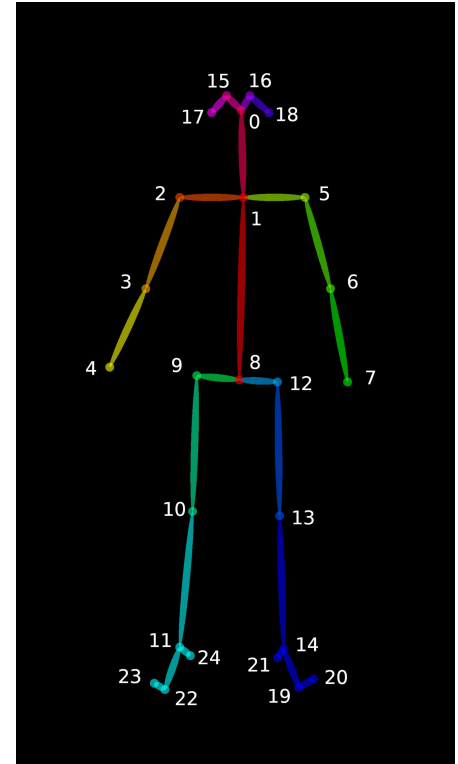
# Technology and How It Works

# The Whole Picture



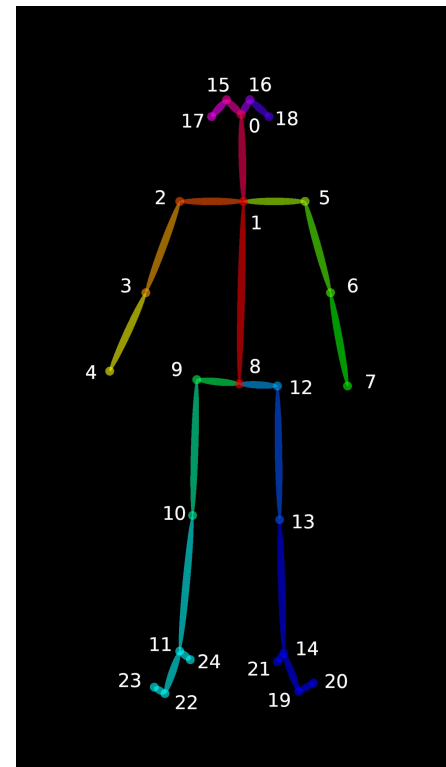
# Pose Detection in Video

- OpenPose library from Carnegie Mellon University
- Pose estimation using Convolutional Neural Networks
- Outputs up to 135 Keypoints, identifying parts of a person's pose



# Vector Analysis

- Can visualize OpenPose keypoints as start and end points of vectors
- Find angles between two of these vectors
- Perform Fast Fourier Transform to determine frequency of this movement
- Combining with action recognition classification can yield the frequency of an action



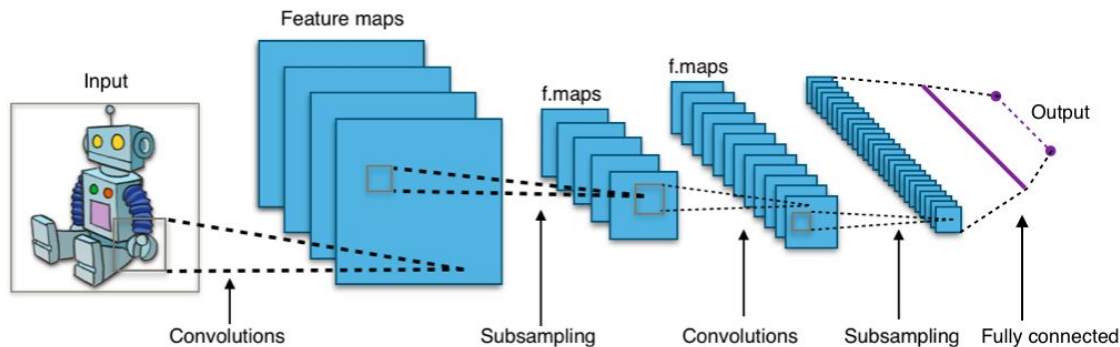
# Action Classification

- Convolutional Neural Network
- Window of keypoints in time as input
- 80% train 20% test method - yielding up to 99% test accuracy
- Classifications labels from KTH dataset

- Running
- Jogging
- Waving
- Clapping
- Boxing

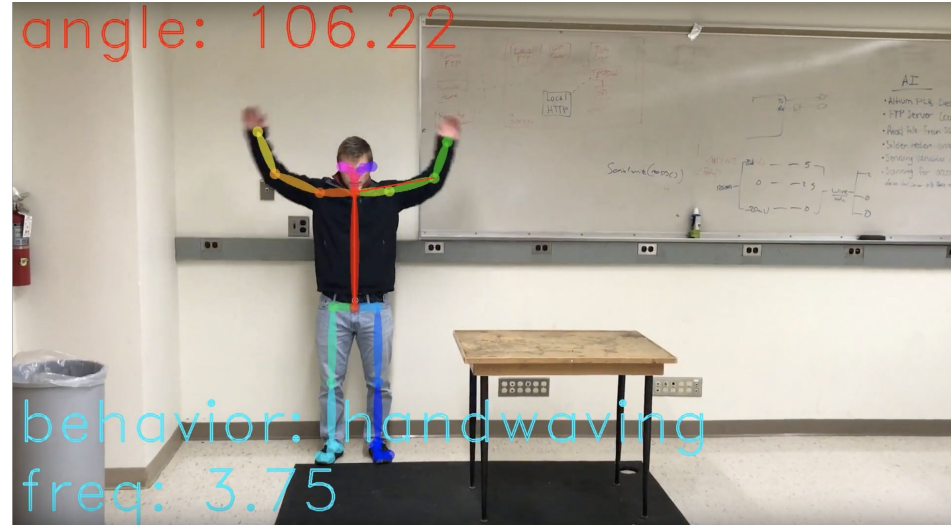
- Limitations:

- CNN works on KTH but not enough data for ASD specific actions
- Different video perspectives limit performance based on KTH dataset



# Presentation of Data

- Video overlay of extracted data
  - Pose overlay
  - Angle information of arms to torso
  - Frequency of motion
  - Action classification
- Augments Medical Professional's information set for diagnosis
- Saving this information for easy recall later
- Allows professional to focus attention on patient



# Specifications

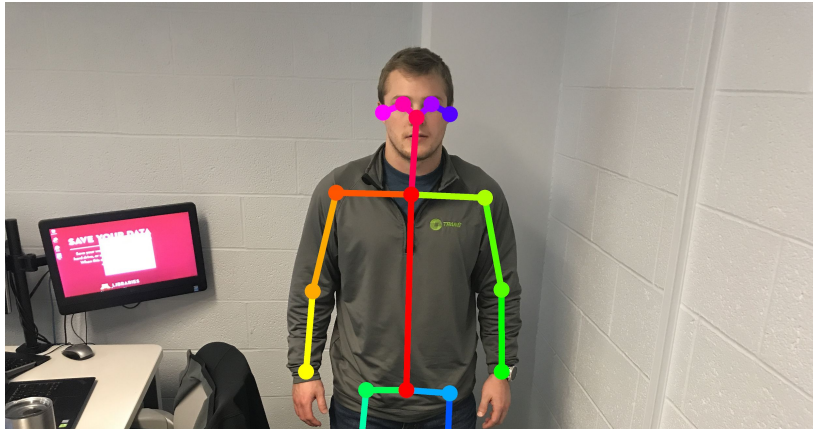
### Tracking Accuracy:

- Detection is no longer done using Optical Flow analysis nor MatLab
- Tracking is done through the 25 key-points detection

### Tracking Distance:

- Tested from 1-20 meters
- Openpose is able to detect very long distances

Specification	Ideal Value	Actual Value
Tracking Accuracy	10 pixels	-
Tracking Distance	3 meters	1-20 meters

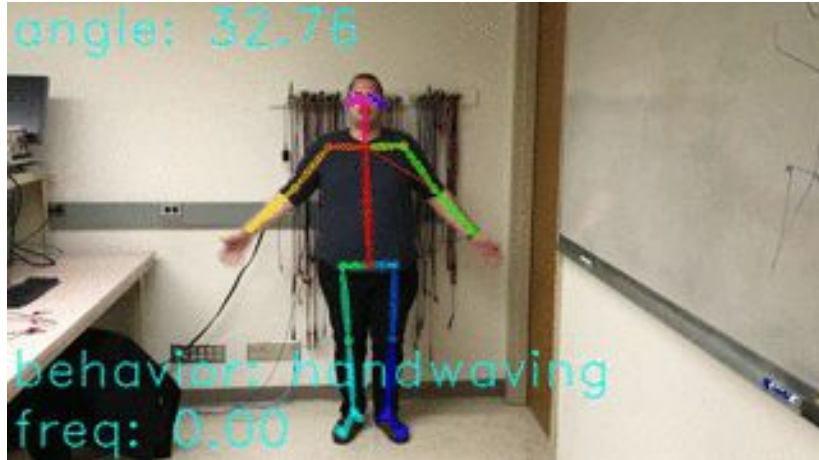




## Camera Focal Length & Image Quality:

- Wide range of different qualities were tested
- All were processed through Openpose with all key-points visible

Specification	Ideal Value	Actual Value
Camera Focal Length	4.3 mm	4.3 mm
Image Quality	12 Megapixels	1.3-12 Megapixels



**Success Rate:**

- 99% success Rate
- Openpose filters out the background noise

**Movement Speed:**

- Detect movements higher than 2 m/s

**Response Time:**

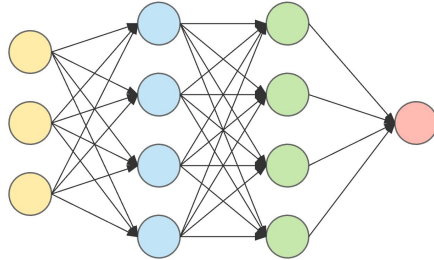
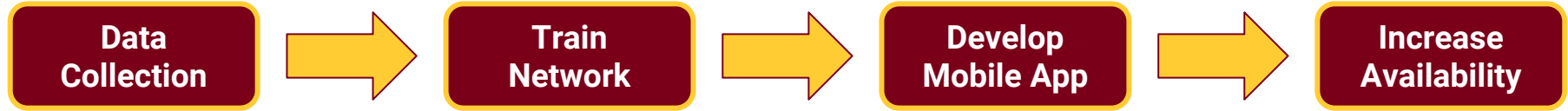
- Approximately 3 Minutes
- Not enough time to implement real-time tracking and classification

Specification	Ideal Value	Actual Value
Success Rate	80%	99%
Movement Speed	2 m/s	>2 m/s
Response Time	4 ms	3 minutes



# Further Development and Marketing Opportunities

# Further Development



# Marketing Opportunities

## **Current Method**

- Current procedure for diagnosis requires multiple screenings with children
  - Occur at 18 and 24 months
- Time consuming
- Requires large amount of medical training and expertise

## **Proposed New Method**

- Video analysis will provide preliminary probabilities to expedite diagnosing process
- Can incorporate screenings into earlier visits
- Will catch movements and patterns that humans can miss

# Additional Benefits

## **Professional**

- Provide unbiased probabilities based on known movement patterns
- Ability to share medical records without the loss of privacy
- Large amounts of data collection
- Minimize extensive professional training required

## **Personal**

- Earlier detection leads to improved long term prognosis
- Increased awareness of unusual patterns within children
- Improved accuracy leading to decreased need of second opinion

# Broader Market and Applications

- Sports and performance
  - More efficiently track training of athletes
  - Analyze technique more precisely
- Physical therapy
  - Monitor progress of patients
  - Track imbalances in patients movements
- Smart technologies
  - Action recognition within smart homes
  - Action recognition within automobiles
- Recognition of other disorders

# Summary of Project

- Utilize an open source tool to determine human pose
- Analyze movement of keypoints
  - Calculations - Angles and frequency of movement
  - More complex action recognition - CNN
- Up to 99% accuracy for train/test data set used with CNN
- Project is a proof of concept, more data is required to improve action recognition
- Future applications hope to develop a more accessible platform to monitor and provide feedback



Demo

# Thank You!

# Questions?

Human Activity Monitoring for Mental Health Assessment

Check out our output examples: <https://bit.ly/2QyZXh7>

Want to work with our source code? <https://github.com/chrispy patt/Senior-Design>



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