Human Activity Monitoring for Mental Health Assessment

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Introduction

A neurodevelopmental disorder is a type of mental disorder that primarily affects the function of the brain and neurological system.

- Symptoms develop during the early stages of childhood
  - Usually continues throughout adulthood.
- ~15% of children in the US were affected by a neurodevelopmental disorder within the last 10 years.
- The focus of this project is on the Autism Spectrum Disorder
  - Approximately 1 in 59 children is diagnosed with autism
- Detecting and treating them early can possibly reduce the severity of life-long effects

Implementation

The open source library, OpenPose, was used to track a person's movement in a video. This yields keypoint data to be further analyzed.

OpenPose + KTH Actions dataset:
- Walking
- Boxing
- Clapping
- Waving

Analysis and Data Extraction:
- Angles between different limbs and other parts of the body
- Fast Fourier Transform to determine frequency of angle changes
- Convolutional Neural Network - training and classifying KTH actions
  - Train and Test method, 80% / 20%
  - Not enough data for ASD related actions

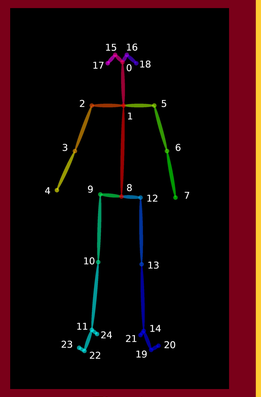


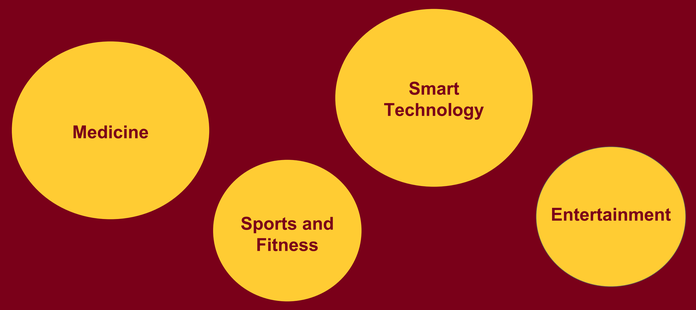
Fig. 1:
Representation of OpenPose's keypoint data

Future Work

- Increase in the number of recognizable patterns
- Improved accuracy of correct assessment with increased data collection
- Real-time video processing
- At home application for areas with limited medical resources
- Change of data extraction based on the recognized pattern
- Expand solution to other applications
  - Physical therapy
  - Intelligent automobiles
  - Sports and entertainment

Objective and Broader Impacts

Increase effectiveness and reliability of human activity monitoring for human health assessment
- Process video of patient behaviors
- Detect subtle movements and behavioral patterns
  - Autism - repetition of unusual hand flapping
- Overlay data onto the video
  - Show the user what patterns and movements are being observed
  - Notify the user if patient performs a concerning behavior that should be further analyzed
- This can also impact other fields in meaningful ways



Results

Results for a Hand Waving Example:

- Angle and frequency of behaviour repetition were both detected, recorded, and displayed on the video
- CNN was successfully able to classify KTH dataset behaviours with a 99% level of accuracy.

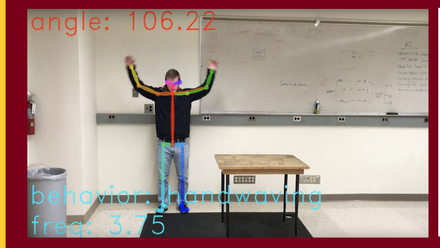


Fig. 2:
Video output showing the frequency of angle changes, action present, and pose information

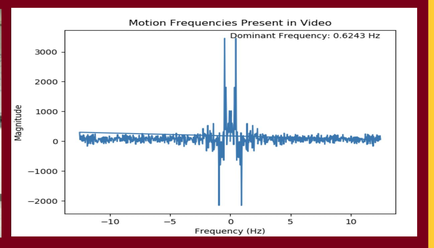


Fig. 3:
FFT output showing the frequency of angle changes

Marketing and Business

Main beneficiaries:
- Families and at risk children/patients
- Medical professionals and healthcare industry

Families & Patients
- Increased access to diagnosis
- Increase in accuracy of initial prognosis
- Earlier detection will lead to improved long-term prognosis

Medical Professional & Healthcare Industry
- Provide more accurate, quantitative measurements
- Ability to share medical records without loss of privacy
- Large amounts of data collection leading to possible new unusual pattern detection