Automated Monitoring of Pre-Kindergarten Children in a Classroom Setting for Screening and Risk Marker Discovery

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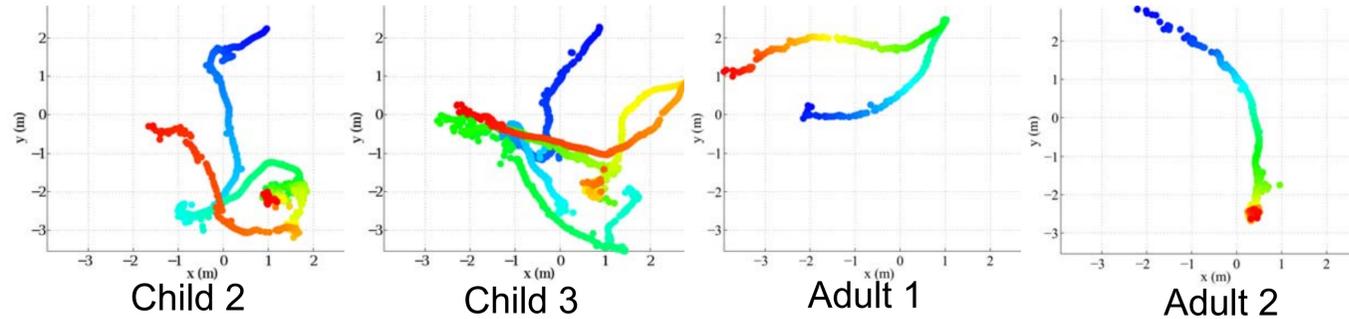
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Overview

- Mental illnesses (Autism, OCD, etc.) can show behavioral abnormalities even at very young ages

- Early diagnosis can steer patients to effective treatments

- Monitoring activities is an important step towards effective utilization of the diagnostic resources

- This work examines the interactions between children and care givers in a free play setting using computer vision tools, similar to the manual work of Legendre and Munchenbach (2011)
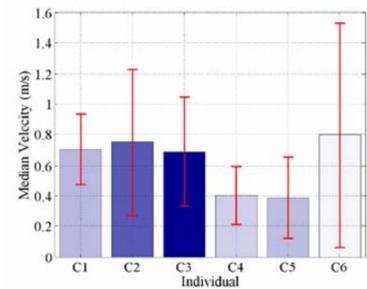
Methods

- Multiple inexpensive sensors (Microsoft Kinects) were installed at the Shirley G. Moore Lab School

- Children and adult caregivers recorded interacting in an unstructured environment

- Sensors employed collected video data as well as distance from the sensor.

- A 3D reconstruction of the classroom that was created to assist in detection of children and adults and track their locations

- Individual appearance models used to recognize and identify the various subjects observed by the different cameras.

- This information used to analyze the degree to which children spent time in close proximity to adults and other children.

- Proximity between people is determined using a combination of actual spatial distance and their individual headings.

- This produces a value between 0-1 indicating shared heading and proximity at any time instant, where larger values indicate higher proximity.

- Two people separated by a distance larger than a preset maximum are assigned zero proximity.

- From this it is then possible to construct a graphical representation of interactions between observed individuals in a given time sequence.

- From automated monitoring it is possible to geometrically determine the amount of movement (velocity) observed persons exhibit during a particular sequence.

Record Classroom Setting   Fusion into 3D environment   Isolate Children in 3D

Results

Child 2   Child 3   Adult 1   Adult 2

Left: Bird's eye view of tracking results on several individuals in the class room. The tracks are colored from red to blue as time progresses. **Right:** Camera placement with respect to the recorded camera sequence. The contours denote the regions of activity with blue corresponding to lowest activity and red corresponding to regions of high activity.
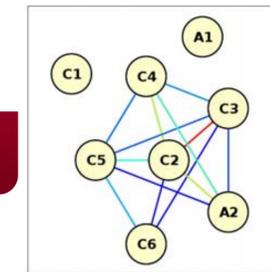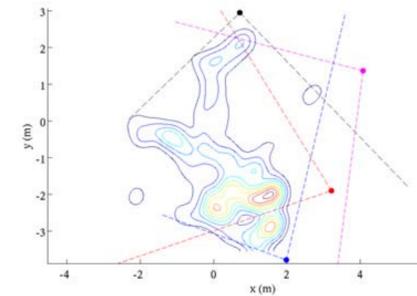
Left: Graphical embedding that depicts the interaction between individuals. Each edge indicates a score of proximity between individuals. Blue indicates the lowest score and red indicates the highest. **Right:** Median velocities of the children being tracked. The relative amount of time that the individual is observed is encoded into the transparency of the bar plot.

Conclusions

This system enables future studies that can incorporate much larger populations without a great deal of arduous manual annotation. In the future, we will look at adding additional modules that will enable the observation of pre-defined behaviors that are relevant to the early course of mental illness. These will be able to take advantage of both the 3D and video data. These are promising but early strides in the effort to use computer vision tools to characterize and identify risk markers in children before the onset of mental illness.

References:
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