INTRODUCTION

- Early detection of children with autism spectrum disorder (ASD) is essential in maximizing the positive impact of autism intervention. However, a diagnosis of ASD is difficult to receive in a timely manner for the large population.
- In this study, we propose a new ASD screening method, namely Gaze-Wasserstein, that is non-invasive, fast, and widely accessible. Based on the gaze tracking and analysis, Gaze-Wasserstein provides objective gaze pattern-based measurements for home-based ASD screening.

We attempt to answer the following socio-S-techno(T) challenges:

- How to design effective visual stimuli for diagnosis of ASD? (S)
- Which is the best global gaze pattern matching algorithm? (T)
- How to optimize the screen time efficiency? (S/T)

BACKGROUND AND MOTIVATION

ASD is defined by concerns in three major domains [1]:

- Social Interaction – abnormal non-verbal behaviors (ex. gaze).
- Communication – lack of spontaneous social initiatory play.
- Behavior – persistent preoccupation with parts over whole.

Prevalence of child autism

- 1 in 68 children in the US has been diagnosed with ASD [2].
- Significant gap between official government estimate and parent survey.
- Limitations of current approach.

Current diagnostic practice

- Low accessibility
- Specialized clinical setting (ADOS)
  - High costs: $3,095 per kit.
  - Duration: 30-45 minutes per modules.

Subjectiveness

- Dependence on the expertise and experience of physicians.

Rationale of our system: Gaze-Wasserstein

- Can provide objective gaze-pattern-based measurements for home-based ASD screening.
- Can be easily deployed on any mobile devices with a front camera.
- Cost-effective, fast, and highly accessible.

METHODS

Two categories of visual stimuli

- Social Scene
- Non-Social Scene

Visual stimuli design

Impact of stimuli type on the system performance

- Accuracy (F-1) for Social and Non-Social Scene [%]
- EER for Social and Non-Social Scene [%]

Algorithm

- Two categories of visual stimuli:
  - Social Scene
  - Non-Social Scene

- Typical gaze trend of ASD subjects
  - Persistent preoccupation → fixed range of view
  - Inability to interpret the relationship depicted in the social scene → wide distribution

Visual Stimuli Design

- Gaze distributions on social scene
  - TD subjects
  - ASD subjects

Optimization

- Long duration → better classification
- Shorter duration → high user compliance

- Achieving high accuracy with low computational cost and limited attention.
- Improved with eye-tracking system.
- Both can be provided by smartphones.

Conclusion

- Using gaze-pattern and social scene stimuli, our method achieved a score accuracy of 93.86 % and equal error rate of 0.33 %.
- The evaluation results demonstrate the feasibility of our ASD screening approach in the clinical practice.
- In order to perform Gaze-Wasserstein, only two technologies are needed:
  - Monitor for visual stimuli.
  - Hardware containing the eye-tracking system.

Bibliography