Gaze-based Screening of Autistic Traits for Adolescents and Young Adults using Prosaic Videos

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ABSTRACT

Autism Spectrum Disorder (ASD) is a universal and often lifelong neuro-developmental disorder. Individuals with ASD often present comorbidities such as epilepsy, depression, and anxiety. In the United States, in 2014, 1 out of 68 people was affected by autism, but worldwide, the number of affected people drops to 1 in 160. This disparity is primarily due to underdiagnosis and unreported cases in resource-constrained environments. Wiggins *et al.* [1] found that, in the US, children of color are under-identified with ASD. Missing a diagnosis is not without consequences; approximately 26% of adults with ASD are under-employed, and are under-enrolled in higher education.

Unfortunately, ASD diagnosis is not straightforward and involves a subjective assessment of the patient's behavior. Because such assessments can be noisy and even non-existent in low-resource environments, many cases go unidentified. Many such cases remain undiagnosed even when the patient reaches adolescence or adulthood. There is a need for an objective, low-cost, and ubiquitous approach to diagnose ASD. Autism is often characterized by symptoms such as limited interpersonal and social communication skills, and difficulty in face recognition and emotion interpretation. When watching video media, these symptoms can manifest as reduced eye fixation, resulting in characteristic gaze behaviors.

Thus, we developed an approach to screen patients with ASD using their gaze behavior while they watch videos on a laptop screen. We used a dedicated eye tracker to record the participant's gaze. With data from 60 participants (35 with ASD and 25 without ASD), our algorithm demonstrates 92.5% classification accuracy after the participants watched 15 seconds of the video. We also developed a proof-of-concept regression model that estimates the severity of the condition and achieves a mean absolute error of 2.03 on the Childhood Autism Rating Scale (CARS).

One of the most common approaches to identify individuals with ASD involves studying family home videos and investigating an

infant's gaze and interactions with their families. However, having an expert carefully inspect hours of home video is expensive and unscalable. Our approach is more accessible and ubiquitous as we can directly sense the gaze of the user while they watch videos. Such sensing can be directly deployed on billions of smartphones around the world that are equipped with a front-facing camera. In our current exploration, we use a dedicated eye-tracker but achieving similar performance using an unmodified smartphone camera is not far-fetched. Our results demonstrate that passively tracking a user's gaze pattern while they watch videos on a screen can enable robust identification of individuals with ASD. Past work has used specially-created visual content to detect ASD, but getting large sets of the population to watch specific videos is hard. Thus, we focus on generic content and selected four prosaic video scenes as a proof of concept.

Our research team includes experienced psychologists to inform the study design and contextualize the performance of the final system. Although our gaze tracking approach cannot yet replace a clinical assessment, we believe it could be valuable for screening individuals passively, as they consume media content on computing devices (*e.g.*, YouTube, Netflix, in-game cut scenes). We believe our efforts in estimating condition severity is also an essential first step towards building an entirely automated, in-home screening, and condition management tool. With rapid advancements in gaze tracking on consumer devices (*e.g.*, Apple iPhone, HTC Vive), autism detection could be included on modern computing devices as a downloadable app or background feature, and potentially reduce the number of undiagnosed cases. Such a system could also track the efficacy of treatment and interventions. Additionally, ASD detection could be used to automatically adapt user interfaces, which has been shown to improve accessibility.

FULL PAPER

Evaluation, results and further details can be found in the full paper PDF available here: https://arxiv.org/pdf/2005.12951.pdf .