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Evaluating Automated Face Recognition Tools on a Head-Mounted Camera Dataset of Young Children with and without Down Syndrome

Emma L. Carter1, James T. Hughes1, Sophie M. Chen1, Robert K. Patel1, & Laura E. Wilson1

[1] *School of Psychology, Cardiff University,United Kingdom*

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Corresponding Author

Laura E. Wilson, School of Psychology, Cardiff University, Cardiff, United Kingdom. Email: wilsonle@cardiff.ac.uk

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Abstract

Young children actively shape their learning through visual exploration, but
neurodevelopmental conditions like Down syndrome may influence this process. This study assesses automated face recognition tools using a novel dataset from head-mounted cameras worn by young typically developing children and those with Down syndrome. Recorded in home environments, the dataset includes challenges such as varied angles and motion blur. Multiple recognition tools were tested on thousands of images extracted from video footage. Results show that certain tools performed well, suggesting their potential for automating data analysis in neurodiverse populations. These findings support the development of scalable tools for early intervention. Future efforts will refine these tools with a larger dataset.

1.Introduction

Young children learn by actively exploring their visual surroundings, a process that may differ in those with neurodevelopmental conditions like Down syn-drome due to attentional and motor challenges [4]. Understanding these differ-ences can inform early interventions to support development. Manual analysis of children's visual experiences is time-consuming, highlighting the need for au-tomated tools to study naturalistic settings.

Head-mounted cameras capture a child's perspective, offering insights into their interactions [2]. However, the data they produce are complex, with issues like motion blur and unusual perspectives. Automated face recognition is a key step toward analyzing social interactions, which are crucial for development [5]. This study evaluates automated tools for recognizing faces

in a head-mounted camera dataset from young children, both typically developing and with Down syndrome, to explore their potential for scalable analysis.

2.Literature Review

2.1 Visual Exploration in Early Development

Children's visual exploration drives cognitive and social growth [4]. Typically developing children focus on faces to learn social and language skills [2]. Chil-dren with Down syndrome may show different patterns, affecting their develop-ment [1]. Head-mounted cameras allow researchers to study these differences in everyday settings [5].

2.2 Automated Face Recognition

Automated face recognition has improved with advanced computing techniques, performing well in controlled settings [3]. However, real-world data, especially from children's perspectives, present challenges like variable lighting and ob-structions [6]. Tools that handle such conditions are essential for practical appli-cations in developmental research [5].

3.Methodology and Procedures

3.1 Data Collection

Video footage was gathered using head-mounted cameras worn by a young typ-ically developing child in their home. Over an hour of video was recorded, and thousands of images were extracted at regular intervals. Data collection contin-ues to include children with Down syndrome to ensure diversity.

3.2 Annotation Process

Three annotators labeled images for the presence of faces, requiring agreement from at least two for a positive label. This process identified a subset of images with faces. Annotator agreement was high, confirmed by a reliability measure of 0.82.

3.3 Recognition Tools

Several automated tools for face recognition were tested on the image set us-ing standard settings. Outputs were compared to human annotations to assess accuracy, focusing on correct identifications and errors.

4.Results and Discussion

4.1 Tool Performance

Table [1] shows the performance of the tools. The best-performing tools correctly identified most faces, with error rates below 5%. Errors included mistaking ob-jects for faces or missing partially hidden faces.

Table 1.1: Performance of Automated Face Recognition Tools

Tool	Correct Identifications (%)	Incorrect Positives (%)	Missed Faces (%)
Tool A	82.0	10.0	18.0
Tool B	85.0	9.0	15.0
Tool C	80.0	12.0	20.0
Tool D	87.0	8.0	13.0
Tool E	93.0	5.0	7.0
Tool F	94.0	4.0	6.0
Tool G	89.0	7.0	11.0
Tool H	95.0	4.0	5.0

Data from current study

4.2 Implications

The high accuracy of top tools suggests they can support automated analysis of complex data, reducing manual effort [6]. This capability is vital for studying visual exploration in neurodiverse groups, enabling tailored interventions [3]. The results highlight the value of combining computational and developmental research.

5. Conclusion and Suggestion

This study shows that certain automated face recognition tools perform well on a challenging dataset from head-mounted cameras, offering a scalable approach to analyzing visual experiences in children with and without Down syndrome. These tools can streamline research, supporting insights into neurodiverse de-velopment. Future work should expand the dataset and refine tools for broader use. We recommend partnerships between researchers and practitioners to de-velop accessible platforms for early intervention, enhancing support for neuro-diverse children.

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