Human Contact Annotator: Annotating Physical Contact in Dyadic Interactions

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ABSTRACT

In dyadic interactions, observing physical contact between interactants is crucial to understand the nature and quality of their interaction. To facilitate the systematic annotation of physical contact from images, we developed Human Contact Annotator, an intuitive tool to label body parts in contact. The tool is publicly available to enable research into analyzing contact signatures and physical contact in dyads during close proximity interactions. In addition to annotating body region-based contact signatures, our tool allows for informative contact segmentation visualizations, which provide quick insights into the nature of touch over an extended period.

KEYWORDS

Parent-Child Interaction; Interaction Analysis; Contact Detection; Pose Estimation; Free Play

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1 INTRODUCTION

Physical contact, or touch, is a key element of human nonverbal communication. It plays a significant role in conveying emotions and intentions [7]. This is particularly important in interactions involving infants, who are still developing their verbal communication skills. In parent-infant interactions, physical contact is crucial for early child development, fostering attachment and emotional regulation [1, 2]. Analyzing physical contact in these interactions provides valuable insights into their quality, and could reveal patterns indicative of their relationship or communication style. Traditionally, the measurement of physical contact in such interactions has relied heavily on self-reported data from questionnaires [3], which can be subjective and limited in terms of the quantization of the contact.

To address the need for a more systematic, quantitative approach, Fieraru *et al.* [6] introduced the concept of *contact signature estimation*, focusing on identifying specific regions of contact on interacting bodies. Building on this, Doyran *et al.* explored the application of vision-based techniques to automatically detect contact signatures at each frame of video recordings of playful parent-infant interactions [4, 5].

The research in [5] provides a standardized way of annotating 21 body parts per person, a compromise that allows the annotation of sufficiently fine-grained touch signatures with a reasonable annotation time and inter-annotator agreement. But, until now, no tool for convenient contact signature annotation was publicly available.

To this end, we developed the Human Contact Annotator tool to facilitate the manual annotation of contact signatures in images and videos. This intuitive tool enables users to label body parts that are in contact, to calculate inter-annotator agreement when multiple annotators are involved, and to visualize contact frequency per body region. The tool is publicly available [1] to support research into the analysis of physical contact in dyadic interactions, offering detailed visualizations that provide quick insights into the nature and frequency of touch over time. By making this tool accessible, we aim to encourage and enhance research into the often-overlooked but crucial aspect of physical contact during close-proximity interactions.

2 SOFTWARE DESCRIPTION

Our software has three main functionalities (Figure 1): annotating contact signatures, calculating inter-annotator agreement between different annotators, and visualizing annotations as heatmaps, respectively. We will explore each of the three functionalities in their respective subsections.

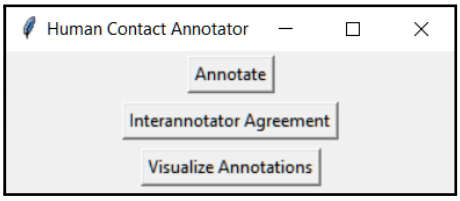

Figure 1: The main menu, showing the three main functions of the annotation tool.

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[1] Code is available on: https://github.com/dmetehan/HumanContactAnnotator.git

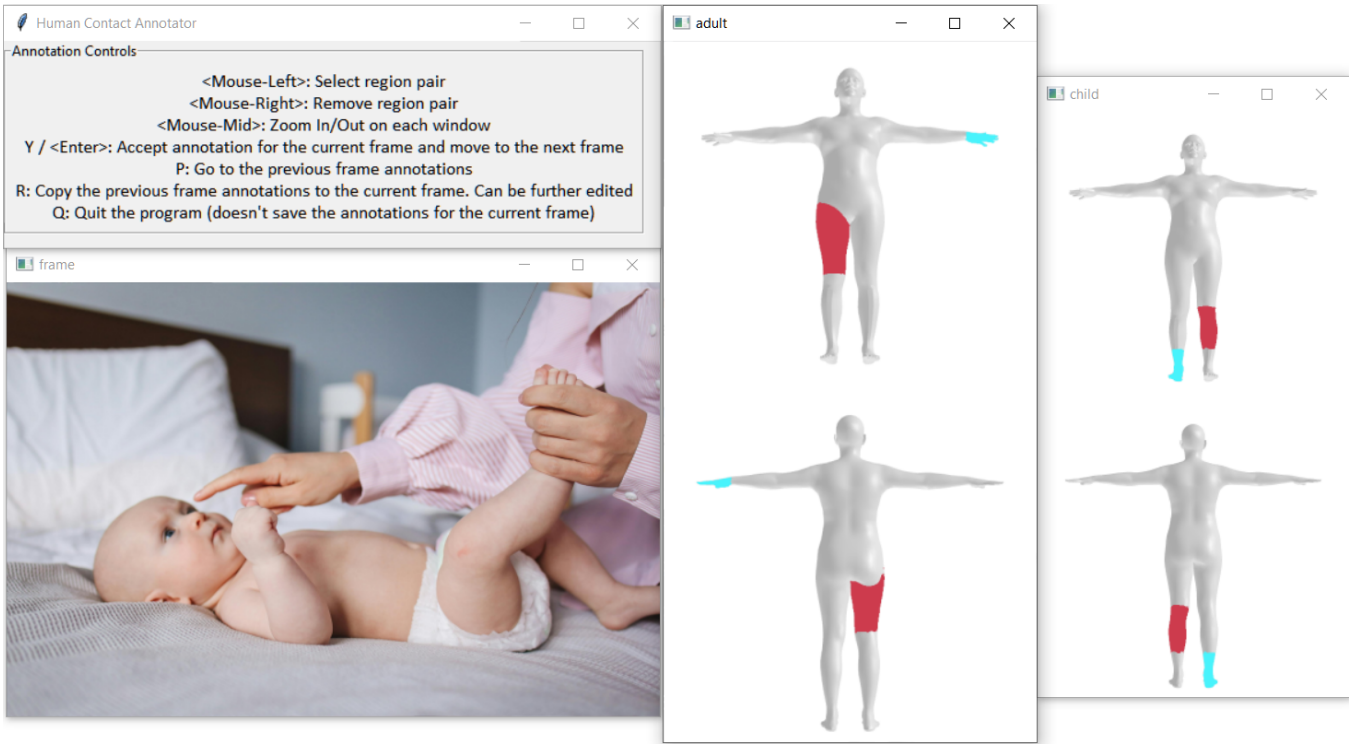

Figure 2: Annotation phase; showing a summary of annotation controls (top left), image of the current frame (bottom left), front and back views of the adult and the child to select the contact regions (right panes, with adult pane selected). The selected body region pairs are highlighted with the same color. Here, the left hand of the adult (in light blue) touches the right foot of the child. Best viewed in color.

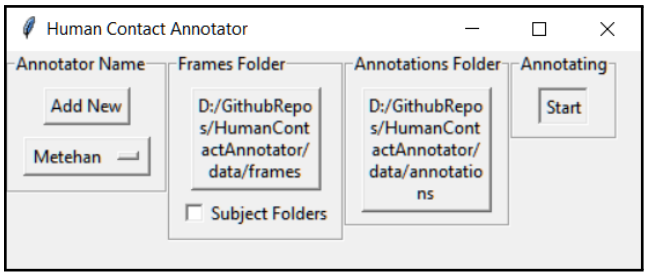

Figure 3: Initializing the necessary fields before annotating.

2.1 Annotating Contact Signatures

A contact signature represents the regions in contact with a set of tuples, where each tuple denotes the contact between a body part for person 1 and a body part for person 2. Our default annotation scheme has 21 regions per body.

Figure 3 shows the necessary fields to choose before annotating. The tool saves a configuration file per annotator and it loads the corresponding configuration, if it exists, after selecting the annotator name. This alleviates the manual work of selecting the necessary folders before annotating.

After the initialization is completed, the annotation phase starts. The user sees four windows which can be moved, scaled and zoomed in/out separately (Figure 2). This allows users to customize the annotation tool for their screen setup and personal preferences.

2.2 Calculating Inter-annotator Agreement

The second functionality of the annotation tool is to calculate inter-annotator agreement with just a few button clicks. The user should select in which annotation folder the annotations are saved. The interface will then show all the annotators in the selected folder. Finally the user can select all or some of the annotators to calculate the inter-annotator agreement between them (Figure 4). The results of the ranking between the annotators are based on the pairwise Cohen's Kappa score.

t The results in Figure 5 show the average pairwise score and standard deviation in parentheses for different types of usage of contact signatures. The column on the right shows the scores for the original contact signature annotations whereas the column on the left shows the contact segmentation scores. In this context, contact segmentation is calculated using contact signature annotations by taking the set of regions that are in contact per person. This results in two sets of body regions without any mapping between them, unlike contact signature annotations. Consequently, inter-annotator agreement scores are typically higher.

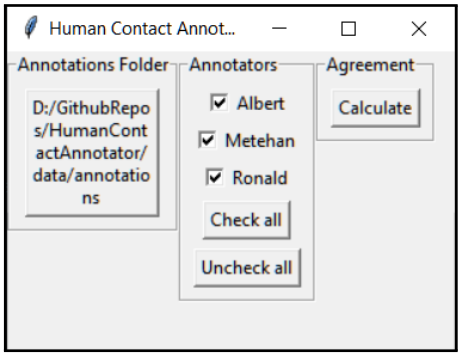

Figure 4: Initializing the annotations folder and the annotators to calculate the inter-annotator agreement.

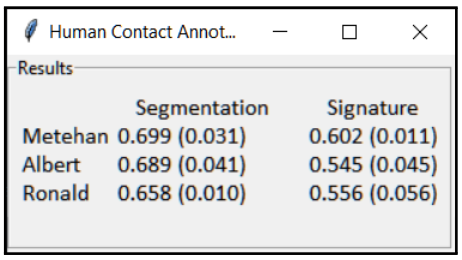

Figure 5: The inter-annotator agreement ranking between the annotators. Mean pairwise Cohen's Kappa and the standard deviation (in parentheses) are reported for both contact segmentation and contact signature annotations.

2.3 Visualizing Contact Frequency Heatmaps

The annotation tool also allows for visualizing the normalized contact frequency per body region of the interacting people. The user selects which annotation file to visualize as in Figure 6. Figure 7 shows the visualization of the contact frequency heatmaps per body region of each person.

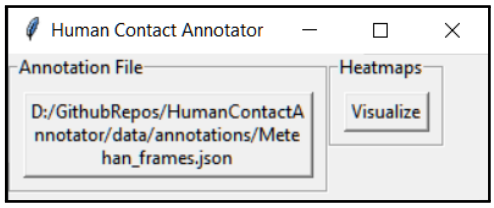

Figure 6: Initializing the annotation file for heatmap visualization

3 DEMO DESCRIPTION

During the demo, the participants will use the tool to annotate contact signatures on a set of dyadic interaction frames. This will allow participants to see and understand the challenges of annotating such fine-grained 3D physical contact information from 2D images. After the annotation phase is completed, the participants will use the tool to calculate their inter-annotator agreement with previous participants to further receive feedback on how they did compared to the others. The demo will be concluded after the participants visualize heatmaps for their own annotations.

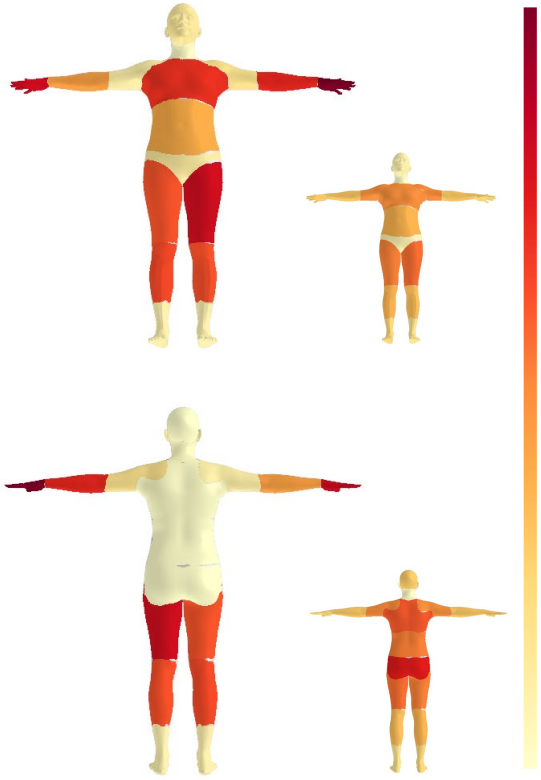

Figure 7: Contact frequency visualization per body region of each person.

We anticipate an impact within the community to draw attention to the potential of analyzing physical contact, a highly overlooked but crucial modality, during dyadic interactions. We hope that this demo will encourage more researchers on human interaction to use our tool to annotate contact signatures as an additional modality to be used in their own multimodal research.

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