UMN X Toyota Dynamic Hand Anthropometry Database

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Reliable 3D dynamic anthropometric data for the hands are needed to improve the fit and design of workspace for diverse populations of occupational workers throughout industrial manufacturing spaces. The purpose of this research and development was to create a multi-functional database of 3D hand scans in a variety of positions of industrial workers. The collaborative research included three research phases: procedure development, data collection and processing, and data analysis. Additionally, 3D hand scans were analyzed to understand advanced anthropometric measurements of the hand, understand measurement change in different positions, and to understand volume and space considerations for hand work. The dataset is meant to be a resource to foster basic understanding of dynamic hand dimensions of an industrial workforce in North America, as well as a toolbox to apply the data into safe and efficient workspace solutions. The procedure included demographics, manual measurements, landmarking the hand and 3D scanning the hand in four positions: splayed, pinch, grasp, and thumb push. Analysis included traditional linear anthropometry, surface measurements, and space measurements. Data was collected from 336 workers across 2 manufacturing facilities in the United States and includes a database of 1344 scans (4 positions per worker).

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Shape & Proportion

Often, proportional information gets eliminated in anthropometric summary tables

Examine & Compare Dynamic Features

Ex. Crease lines of the palm in relation to functional product features.

Direct Comparison to Product

Often, measurements are not enough to understand fit. 3D scans allow us to directly compare all aspects of the hand in relation to a product.

New Product-Specific Measurements

Study the hand in relation to product features to create hand envelopes and clearances

Image 1. Value of 3D Databases.

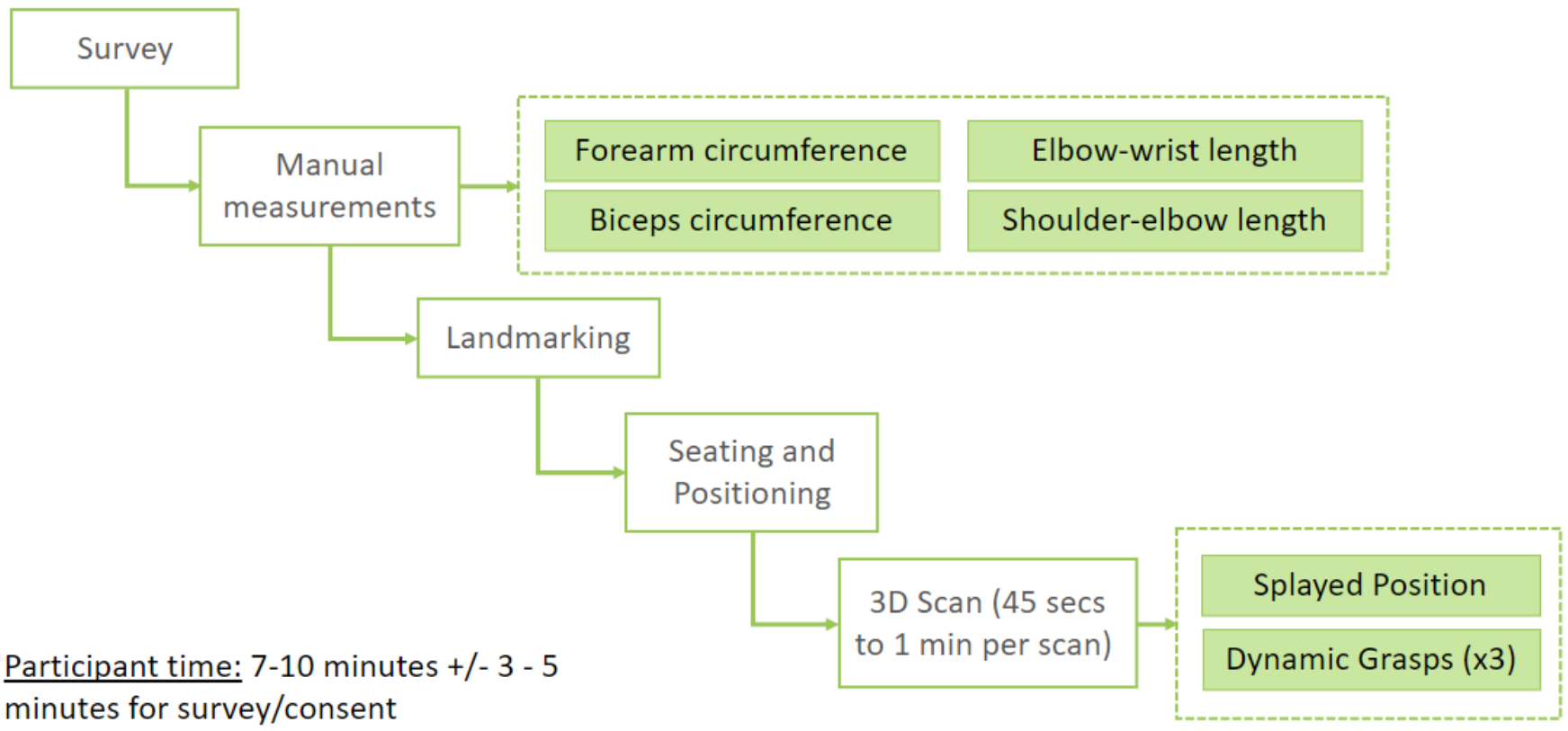


Image 2. Data Collection Methodology.

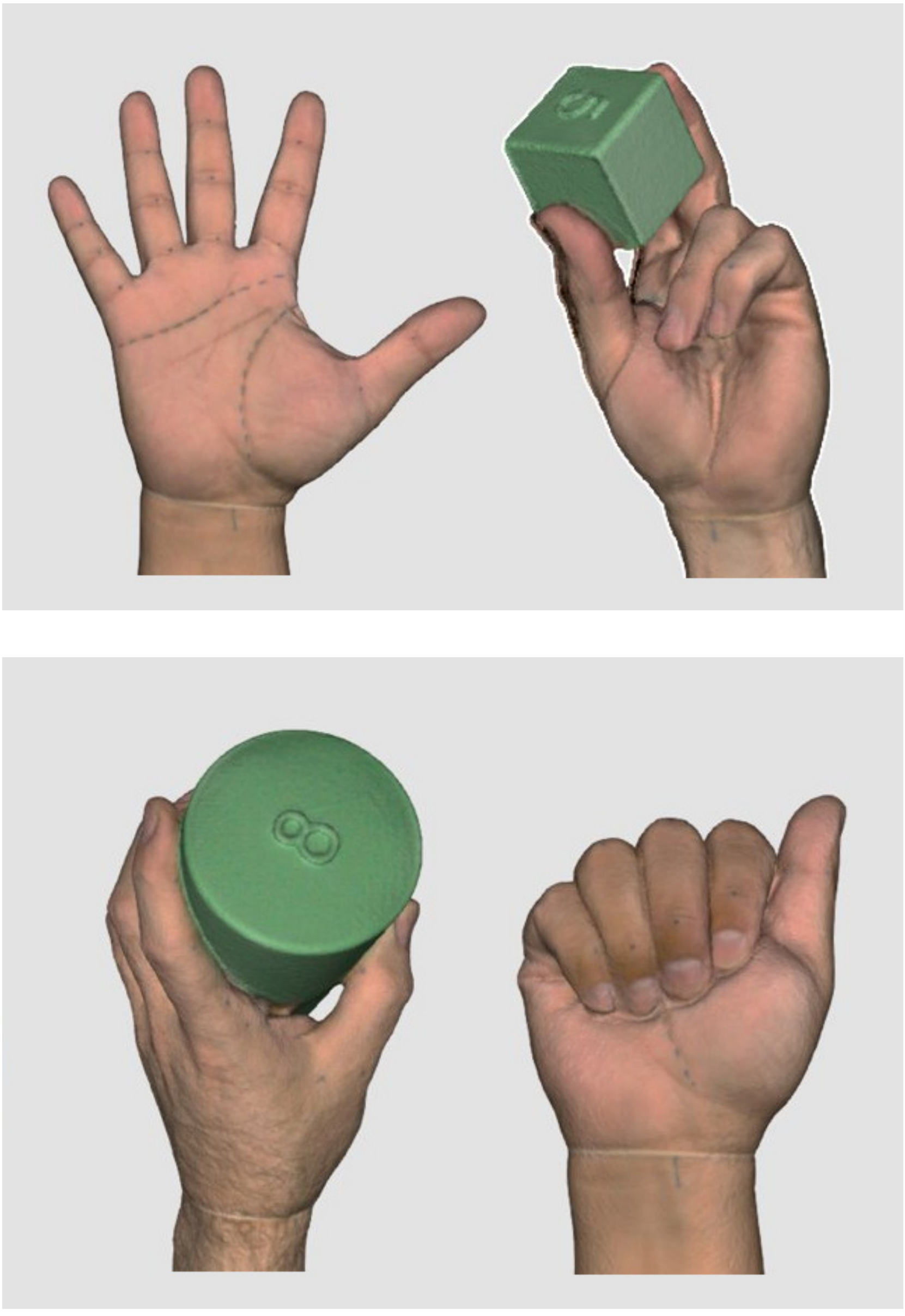


Image 3. Four Hand Positions Collected.

Linear - Length

Maximum distance between two points measured vertically.

Linear - Width

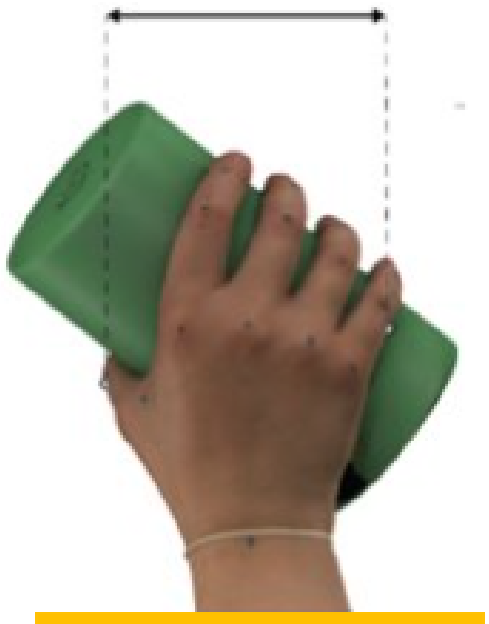
Maximum distance between two points measured horizontally.

Linear - Thickness

Depth of the object of study (palm, hand, finger).

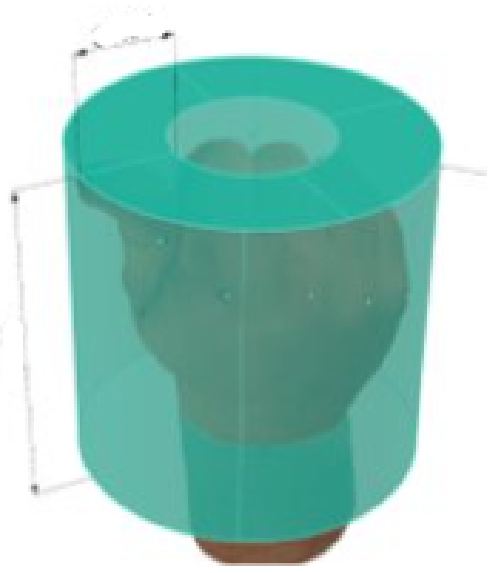
Circumferences

Distance from two or more desired landmarks that follow the surface of the hand.



Space

Space measurement between two points aligned to X, Y, or Z axis).



Envelopes

Bounding boxes or cylinders that visually represents the maximum limits of the hand.

Image 4. Six Different Measurement Types.

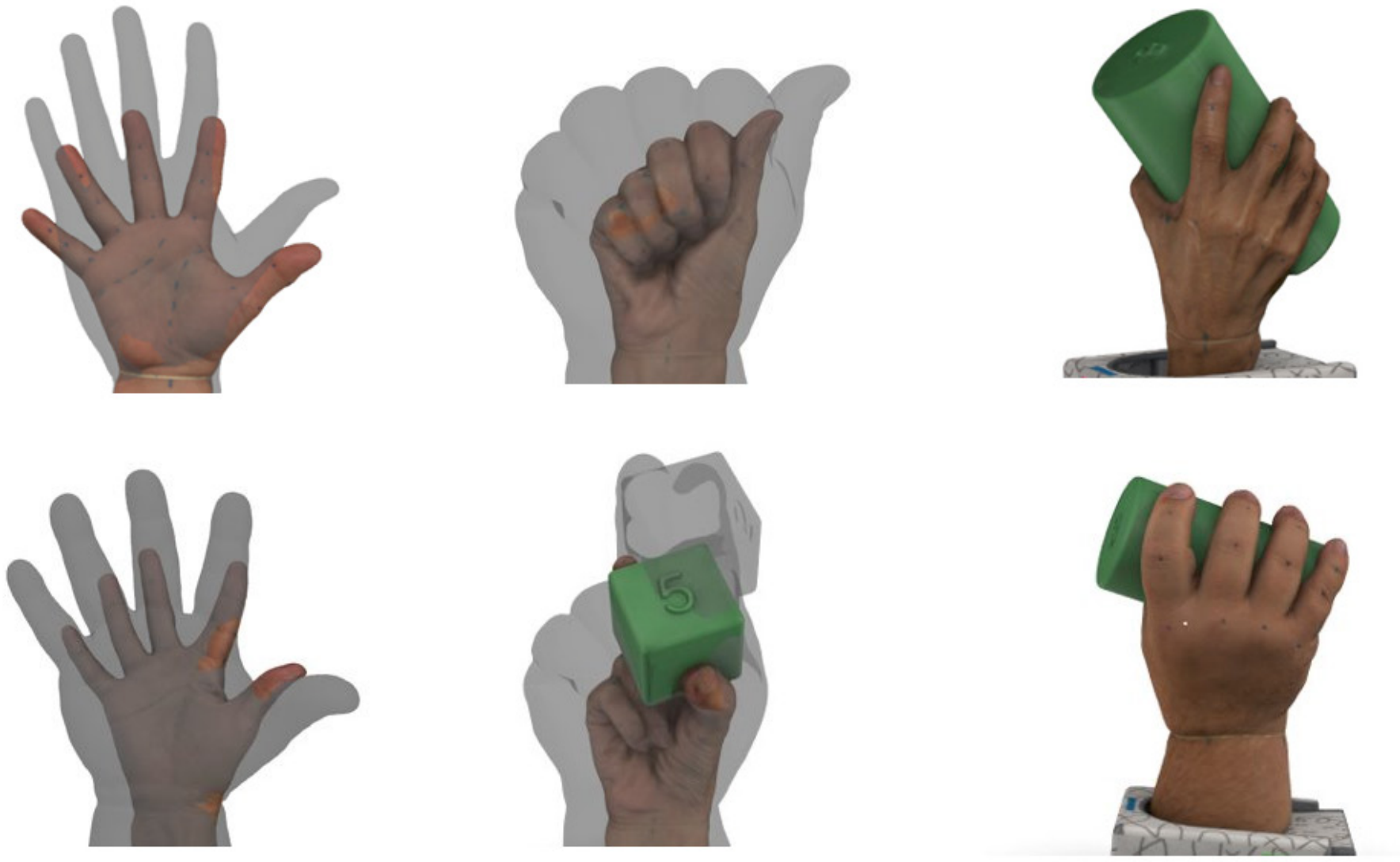


Image 5. Differences between Minimum and Maximum hands.

Image 6. Toyota Team Members Scanning at the Facility.