



Fitting Simulation Based on Mobile Body Scanning for Wheelchair Users

Ryosuke Ichikari, Masaki Onishi, Takeshi Kurata
National Institute of Advanced Industrial Science
and Technology (AIST), Japan

CSUN AT Conf. 2018@San Diego
Session:IND-081
March 23rd, 2018 (8:00 AM)

Fashion for wheelchair users

- Fashion: Important for the wheelchair users to improve quality of life (QoL) and return to society
- Problems of making their garments:
 - lack of items, costs (order-made or modified from normal garments)
 - market size, difficulty for keeping business
 - consumers have highly individualized needs



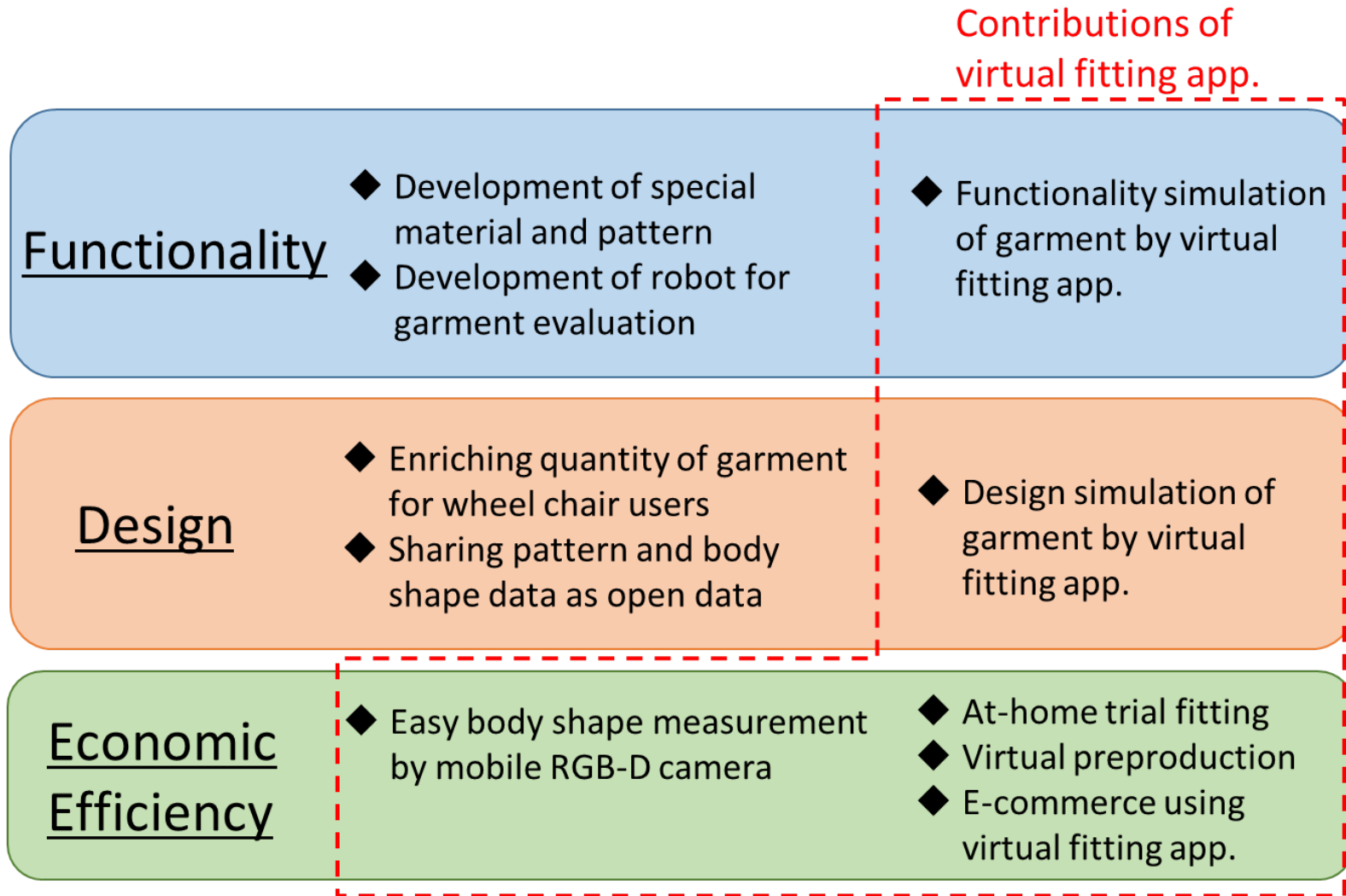
Fashion show at
Koku-Reha collection
2012

Projects for people with physical disabilities and special needs

- Fashion-able (2011-, EU)
 - Fashionable footwear for diabetic feet
 - Fashionable clothing for wheelchair users
 - High-performing textile compression bandages
- Our projects (2012-, Japan)
 - Sustainable research project for manufacturing ideal clothes for wheelchair users
 - Simultaneously improving *functionality*, *design*, and *economic efficiency*
 - Research institutes, a fashion school, apparel-CAD companies, garment manufacturers are involved.

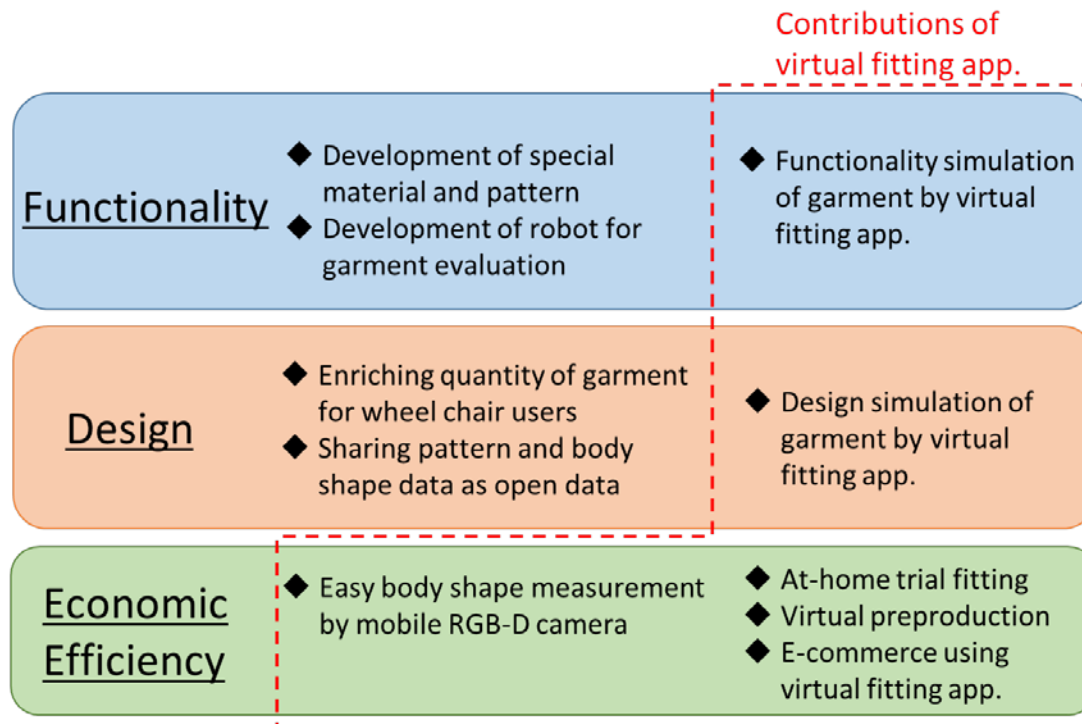


Research elements in our project



Virtual Fitting App.

- Virtual trial fitting anywhere-anytime with smartphone.
- Simulation of garment functionality and its design
- Mobile 3D body measurement by RGB-D camera

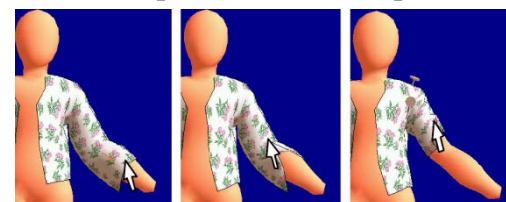


Related Works

- Researches related to clothes fabrication
 - Stefan et.al. (ISMAR2011): Fitting simulation based pre-captured clothes with various poses
 - Igarashi et.al.(UIST2002): Interactive simulation of sewing the parts and fitting on CG doll
- MR-based virtual fitting systems
 - EON Reality [Eon Interactive Mirror](#) simple cloth simulation
 - MR Fitting Simulation (Our previous work)
 - Superimposing scanned clothes CG model in real-time
 - Did not adopt measurement of target's body and rigorous cloth simulation



[Stefan 2011]



[Igarashi 2002]



[Eon Interactive Mirror]



[Ichikari 2014]

Overview of virtual fitting app.

Preliminary Operation

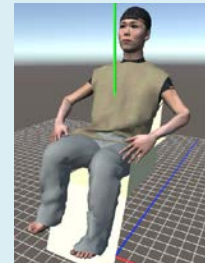
C1. Virtual Fitting for Standard Model



Fitting Result for Standard Model

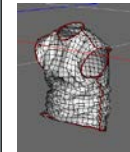
Runtime

C2. Virtual Fitting for Deformed Standard Model



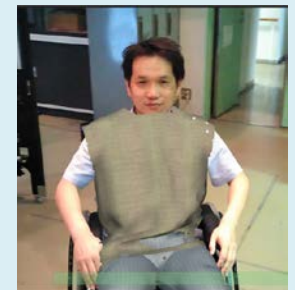
Propagating the fitting result to the deformed standard model, collision simulation with the seat, and fitting adjustment

Only Clothes



Runtime

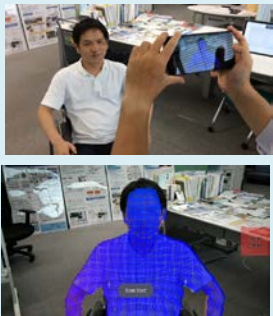
D. Visualization



Visualizing fitting result with target body in mobile app.

Runtime

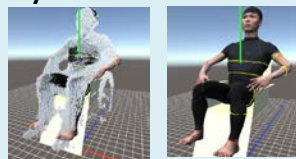
A. Mobile Body Scanning



Measured Data

Runtime

B. Deforming Standard Model by Measurement



Matching correspondence of body parts, posture, and deformation

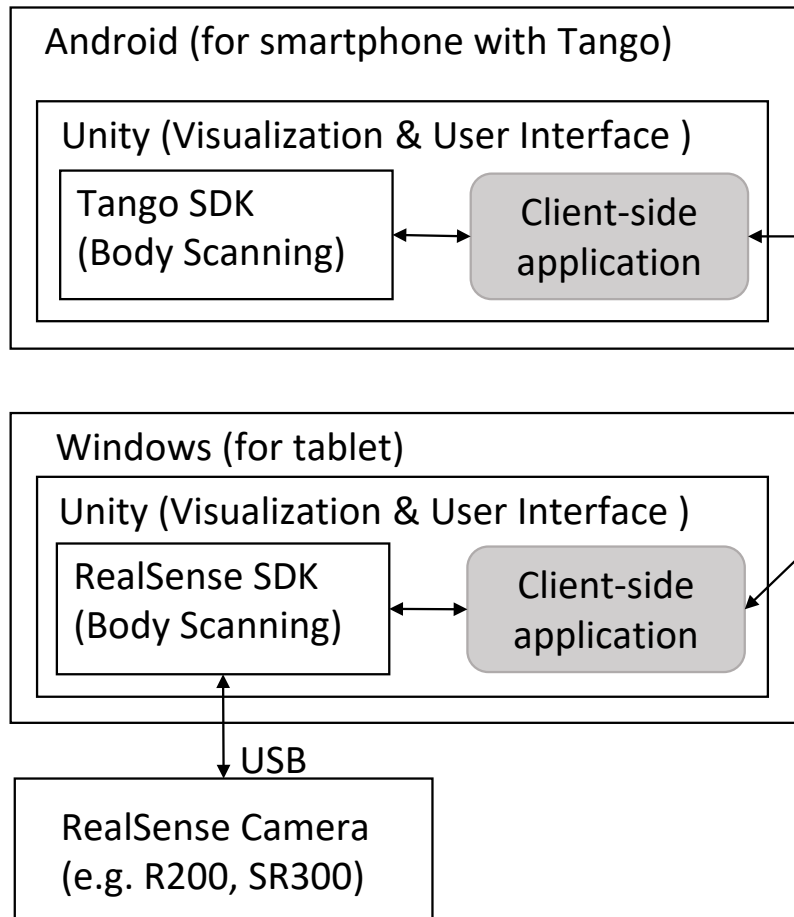
Deformed Standard Model

Functionalities of virtual fitting app.

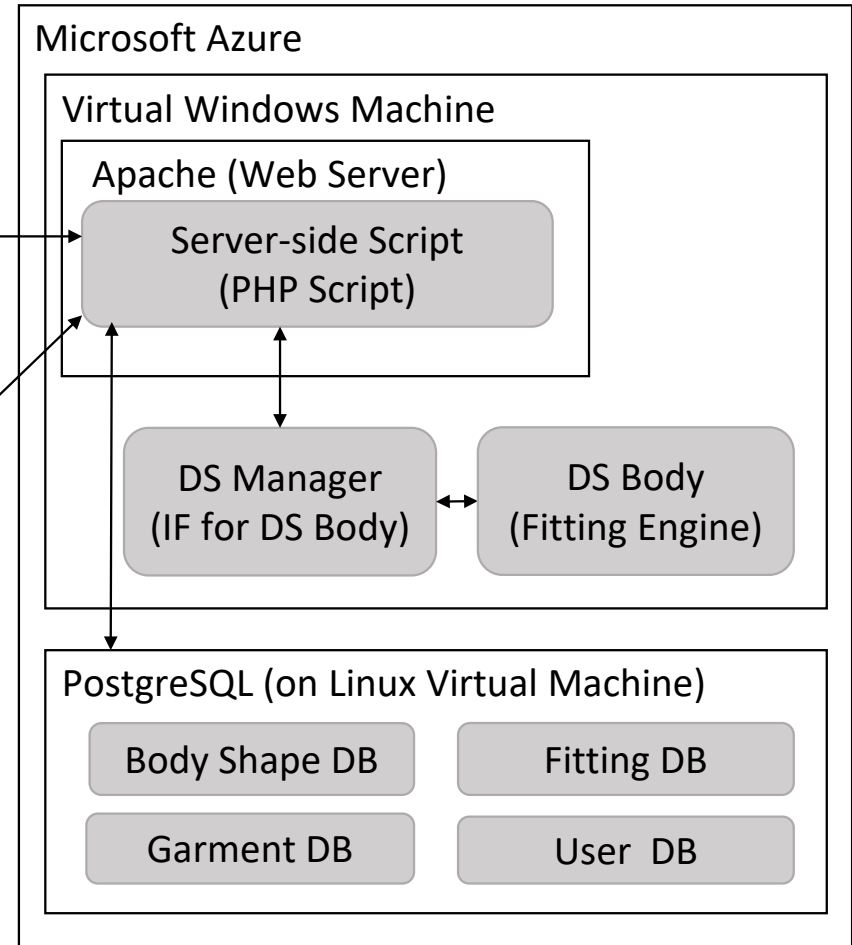
- (1) Ability to allow wheelchair users to **try clothes virtually** while they are in **a seated position** (i.e., on the wheelchair)
- (2) Ability to realize **automated and accurate fitting simulation** using examples
- (3) Ability to realize three-dimensional **physical measurement** function using a common mobile device
- (4) Ability to verify fitting results by three-dimensional **visualization** using a common mobile device
- (5) Ability to develop a **form database** by collecting the results of three-dimensional measurements on a server
- (6) Ability to provide **reliable data required in the garment manufacturing industry** (CAD), and support CAD data format.

System Configuration

Client-side



Server-side

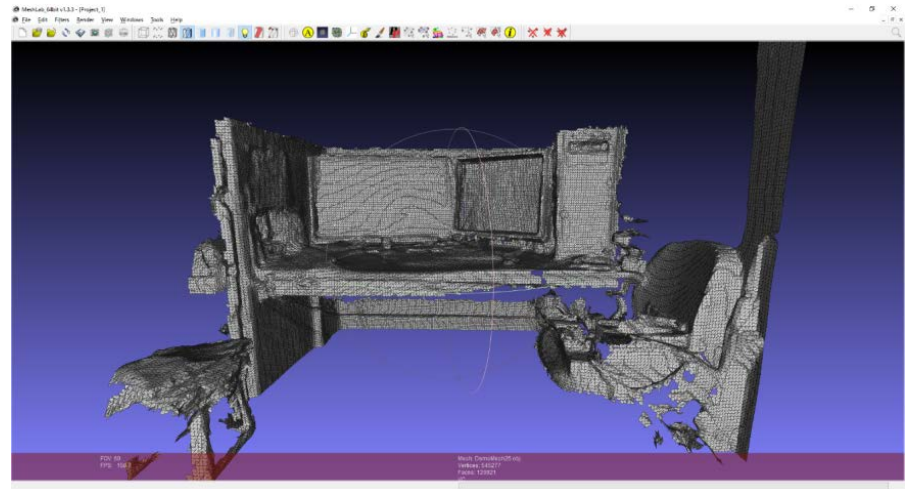


Device (Tango)

- Google's AR(Augmented Reality) Platform
- Enables camera tracking and 3D reconstruction by a depth camera
- Can be utilized as a mobile body scanner



Lenovo's phablet Phab 2 pro



Step A

Preliminary Operation

C1. Virtual Fitting for Standard Model



Pattern data



Standard model



Fitting

Fitting Result for Standard Model

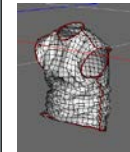
Runtime

C2. Virtual Fitting for Deformed Standard Model



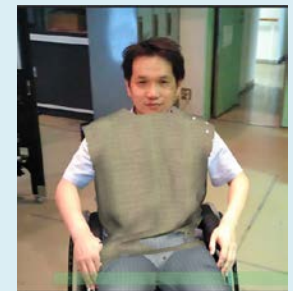
Propagating the fitting result to the deformed standard model, collision simulation with the seat, and fitting adjustment

Only Clothes



Runtime

D. Visualization



Visualizing fitting result with target body in mobile app.

Runtime

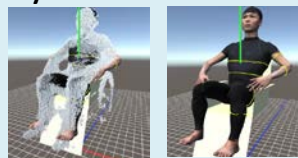
A. Mobile Body Scanning



Measured Data

Runtime

B. Deforming Standard Model by Measurement



Matching correspondence of body parts, posture, and deformation

Deformed Standard Model

Mobile body measurement without contact



Step B

Preliminary Operation

C1. Virtual Fitting for Standard Model



Fitting Result for Standard Model

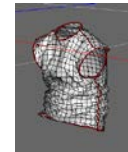
Runtime

C2. Virtual Fitting for Deformed Standard Model



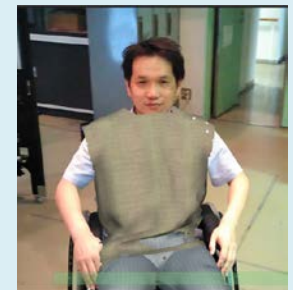
Propagating the fitting result to the deformed standard model, collision simulation with the seat, and fitting adjustment

Only Clothes



Runtime

D. Visualization



Visualizing fitting result with target body in mobile app.

Runtime

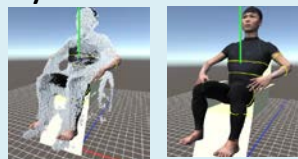
A. Mobile Body Scanning



Measured Data

Runtime

B. Deforming Standard Model by Measurement

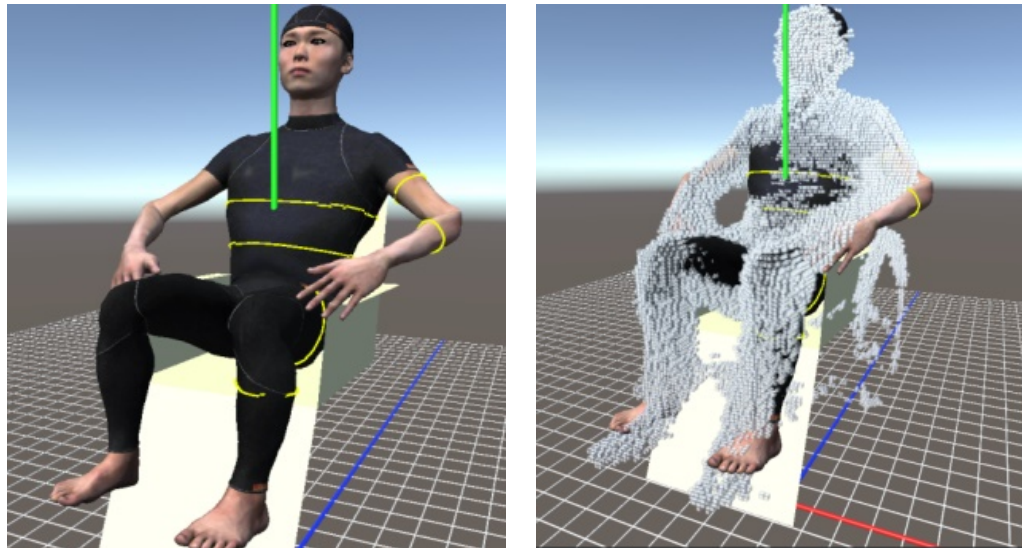


Matching correspondence of body parts, posture, and deformation

Deformed Standard Model

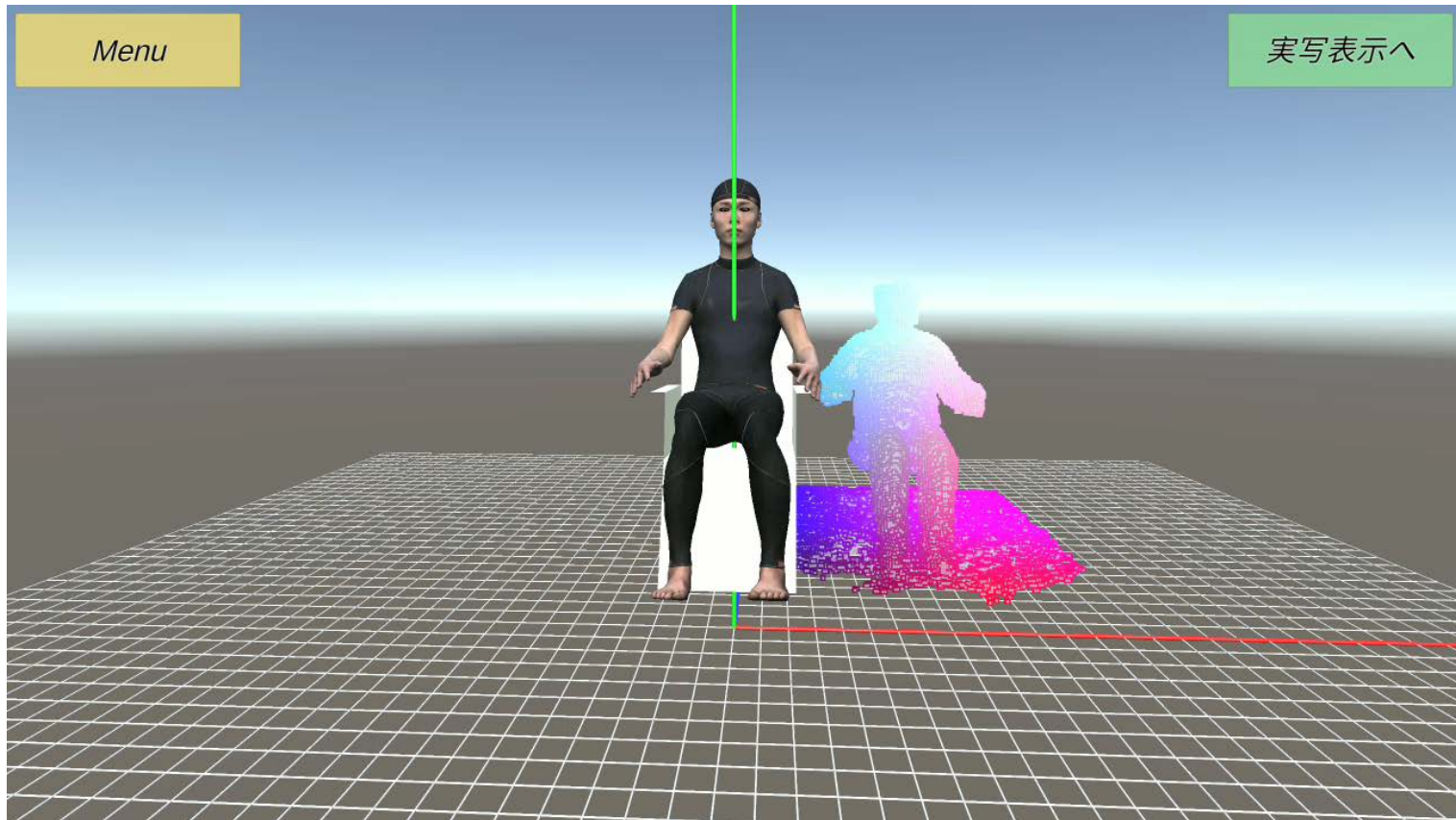
Correspondence between a standard model and the measured model

- Scanned geometry is converted to a homology model
 - Matching correspondence between a homology model and scanned geometry.
 - Fitting simulation engine assumes that a homology model is used as a target body
 - Scanned geometries are noisy
- AIST's Dhaiba model is used as a homology model



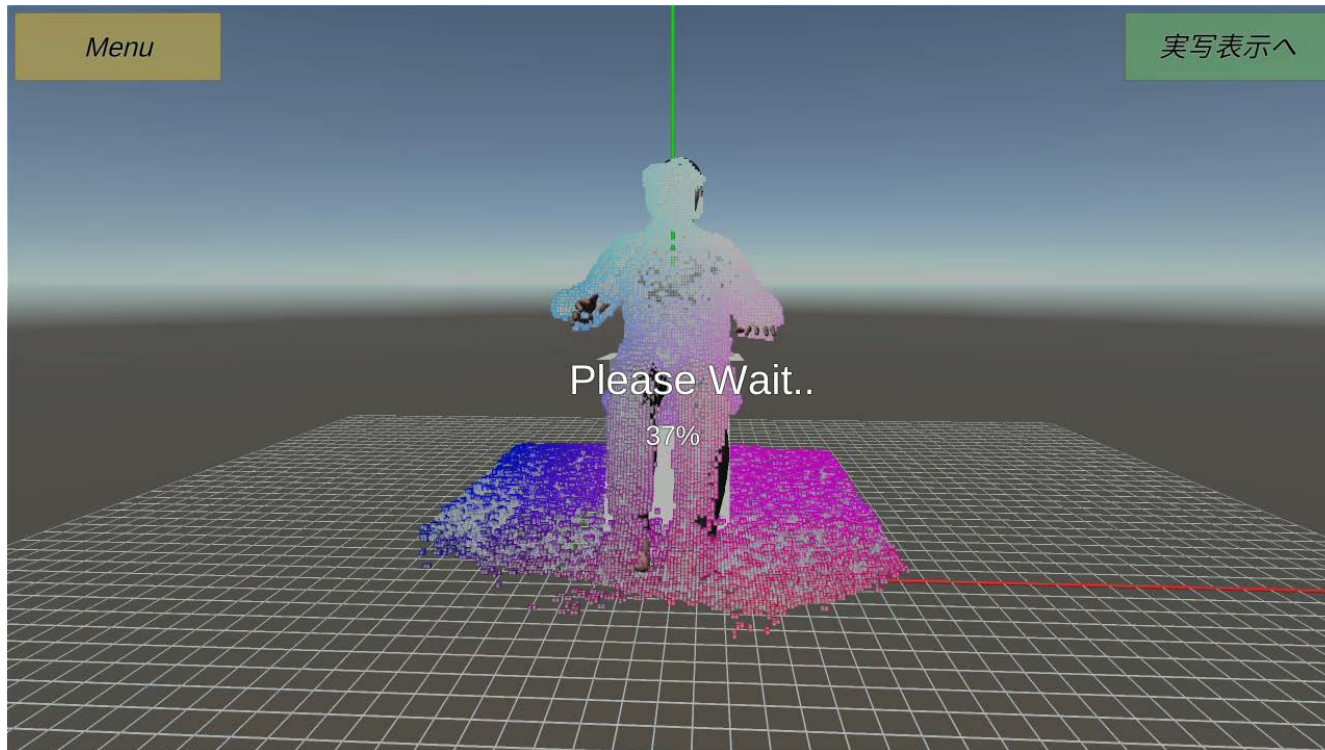
Matching joint angles of bodies with images

- User can changing joint angles while checking appearance from various viewing angles (semi-automated process)
⇒ Supposed to be fully-automated in the future



Body shape fitting by blend shape deformation

- Deforming Dhaiba model by changing blend weights between body with various heights and weights
- Checking the similarity of shape by calculating distance between the closest pair of points on the surfaces



Step C1

Preliminary Operation

C1. Virtual Fitting for Standard Model



Pattern data



Standard model



Fitting

Fitting Result for Standard Model

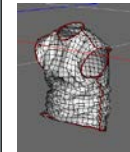
Runtime

C2. Virtual Fitting for Deformed Standard Model



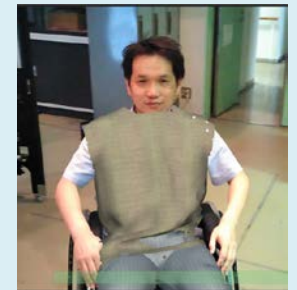
Propagating the fitting result to the deformed standard model, collision simulation with the seat, and fitting adjustment

Only Clothes



Runtime

D. Visualization



Visualizing fitting result with target body in mobile app.

Runtime

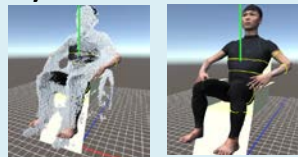
A. Mobile Body Scanning



Measured Data

Runtime

B. Deforming Standard Model by Measurement



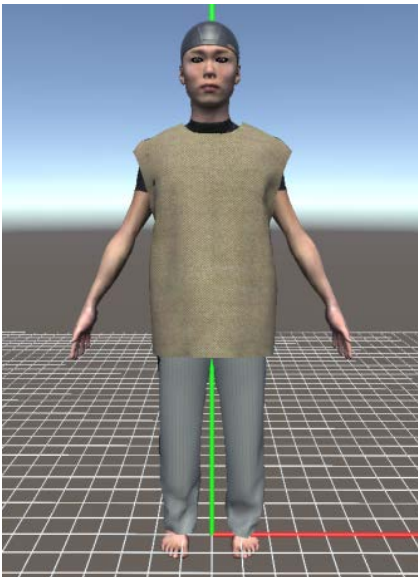
Matching correspondence of body parts, posture, and deformation

Deformed Standard Model

Fitting to Standard Model (Preliminaryly Operation)

- Adopts Dressing Sim Body (DSBody)
 - Fitting simulation engine developed by Digital Fashion Ltd.
- Simulation results for the human model can be propagated to another human model with homology

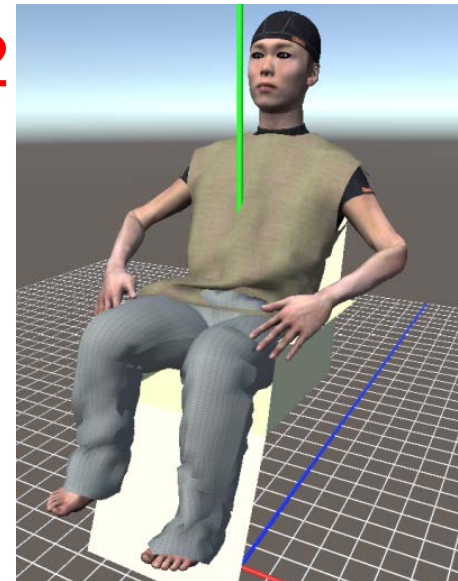
Step C1



Fitting for standing standard model
(**Semi-automatic process with GUI**)

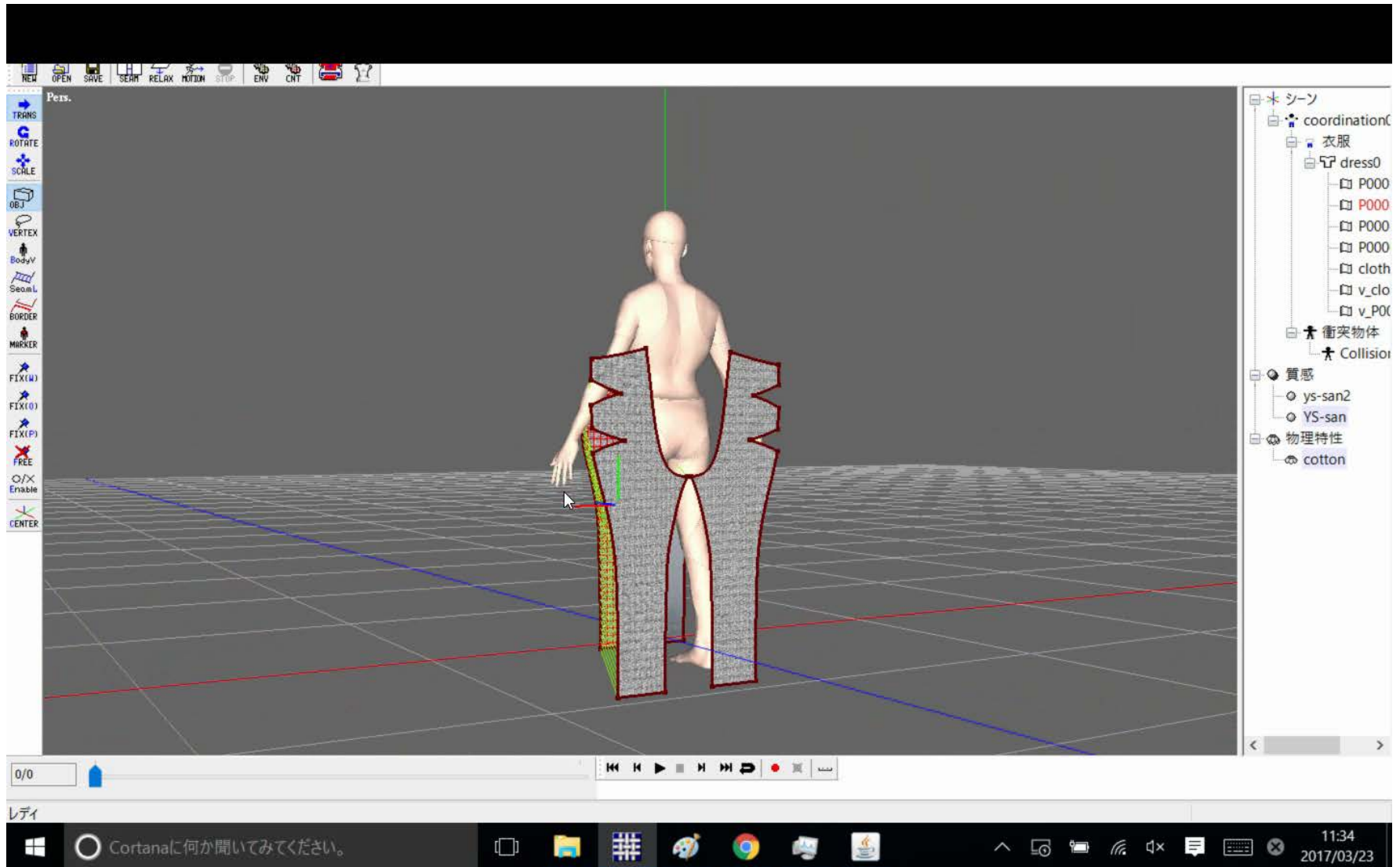
Step C2

Automatic
propagation



Fitting for sitting model with different
pose and shape (**Automatic**)

Detailed operation of fitting for standard model



Step C2

Preliminarily Operation

C1. Virtual Fitting for Standard Model



Pattern data



Standard model

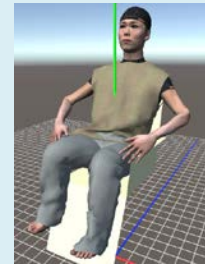


Fitting

Fitting Result for
Standard Model

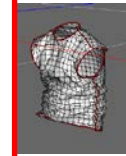
Runtime

C2. Virtual Fitting for Deformed Standard Model



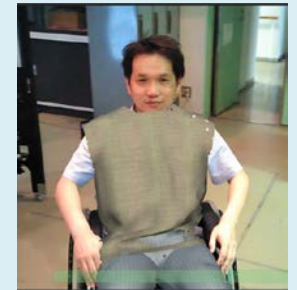
Propagating the fitting
result to the deformed
standard model, collision
simulation with the seat,
and fitting adjustment

Only
Clothes



Runtime

D. Visualization



Visualizing fitting
result with target
body in mobile app.

Runtime

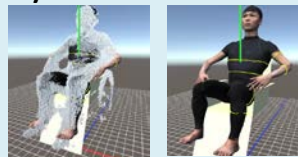
A. Mobile Body Scanning



Measured
Data

Runtime

B. Deforming Standard Model by Measurement

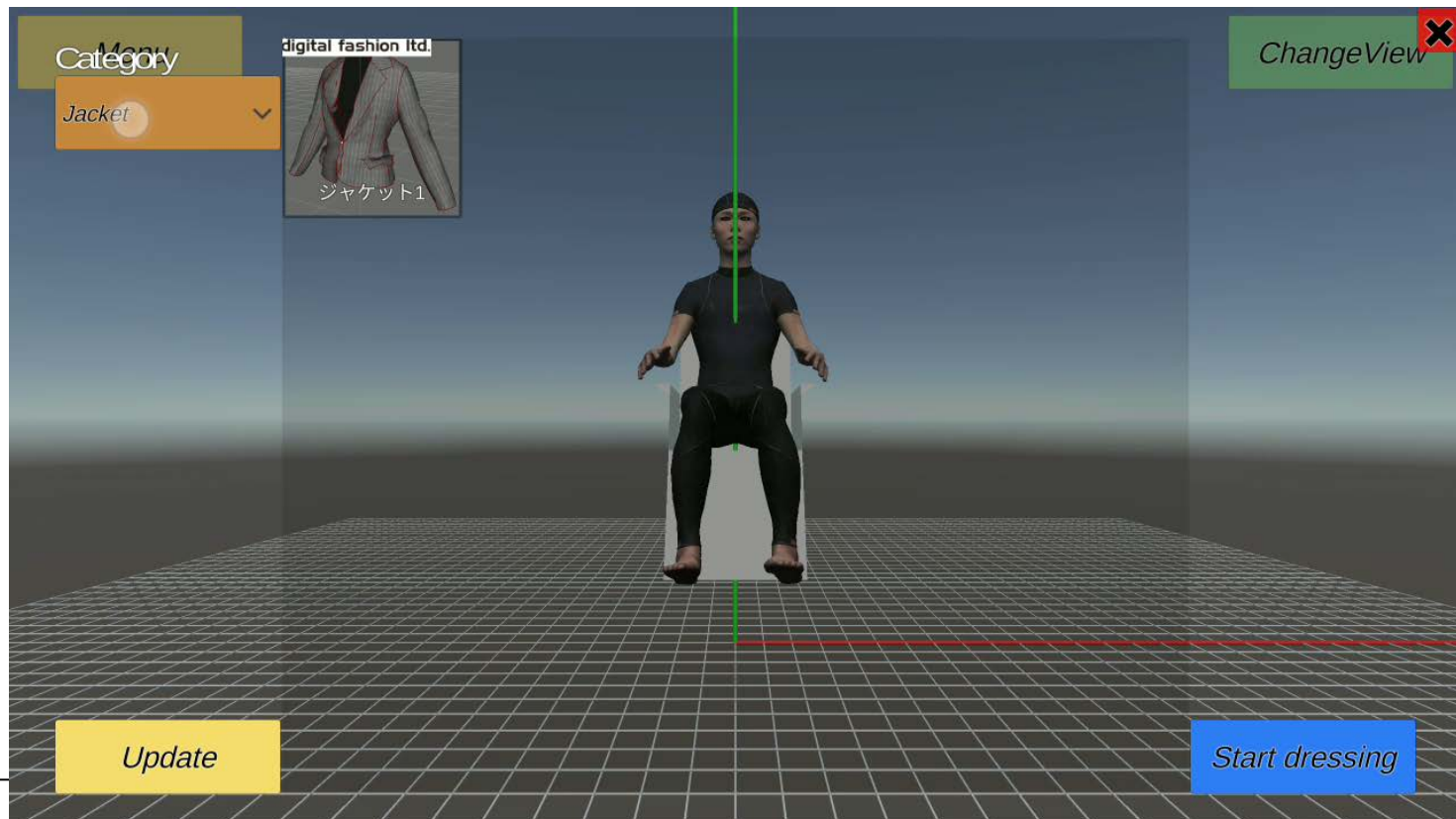


Matching
correspondence of
body parts, posture,
and deformation

Deformed
Standard
Model

Interface for selecting garments

- User can select the garments to be fitted on their body from choices with thumbnails
- Can be connected to web-site of manufacturers
- User can trigger starting simulation after garment selection



Step D

Preliminarily Operation

C1. Virtual Fitting for Standard Model



Pattern data



Standard model



Fitting

Fitting Result for
Standard Model

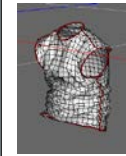
Runtime

C2. Virtual Fitting for Deformed Standard Model



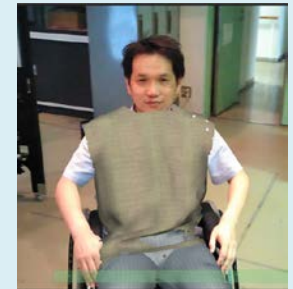
Propagating the fitting
result to the deformed
standard model, collision
simulation with the seat,
and fitting adjustment

Only
Clothes



Runtime

D. Visualization



Visualizing fitting
result with target
body in mobile app.

Runtime

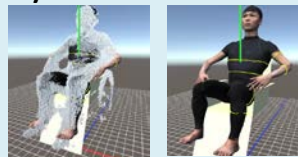
A. Mobile Body Scanning



Measured
Data

Runtime

B. Deforming Standard Model by Measurement

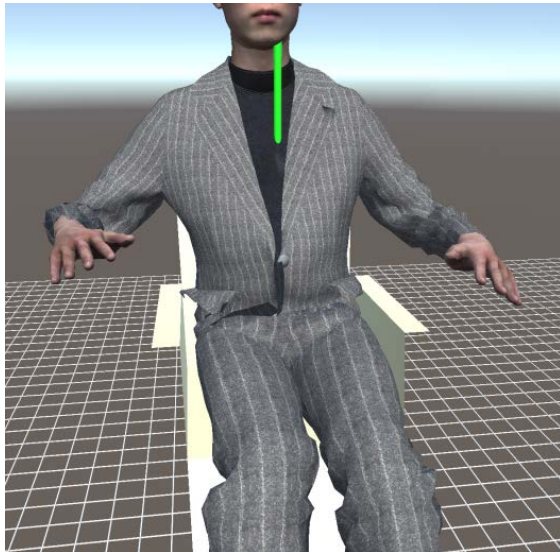


Matching
correspondence of
body parts, posture,
and deformation

Deformed
Standard
Model

Visualization of the virtual fitting results

- Fitting results are displayed on the client smartphone
 - Full-CG visualization: Fitting simulation result on to deformed Dhaiba model
 - AR visualization: Simulation results are superimposed onto real images captured during body scanning



Full-CG visualization



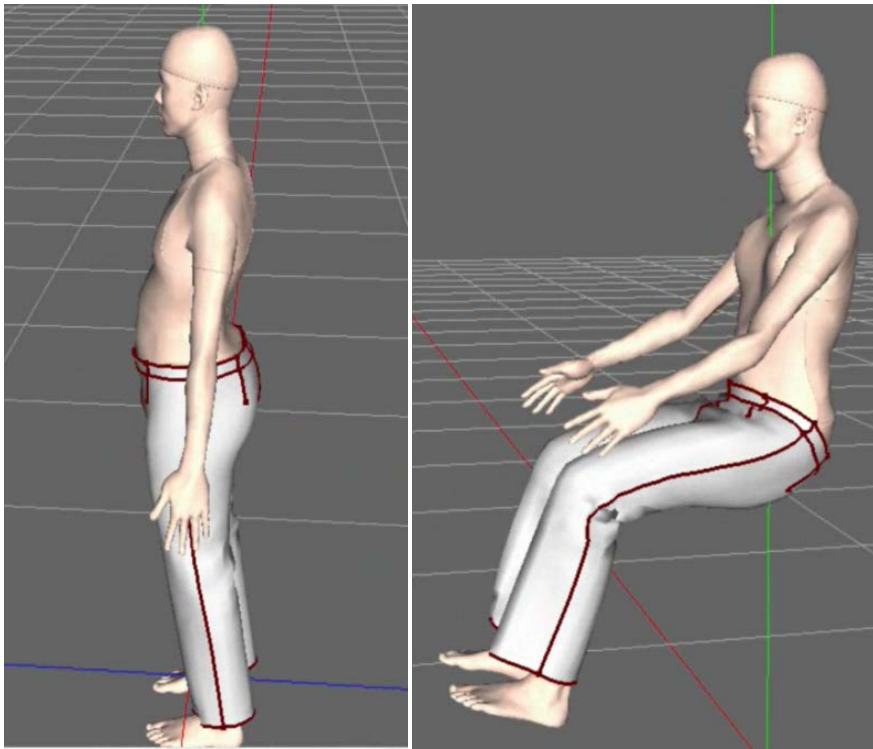
AR visualization

Various Fitting Results



Remarkable Result 1

- Results of simulation using specially designed pattern for sitting position



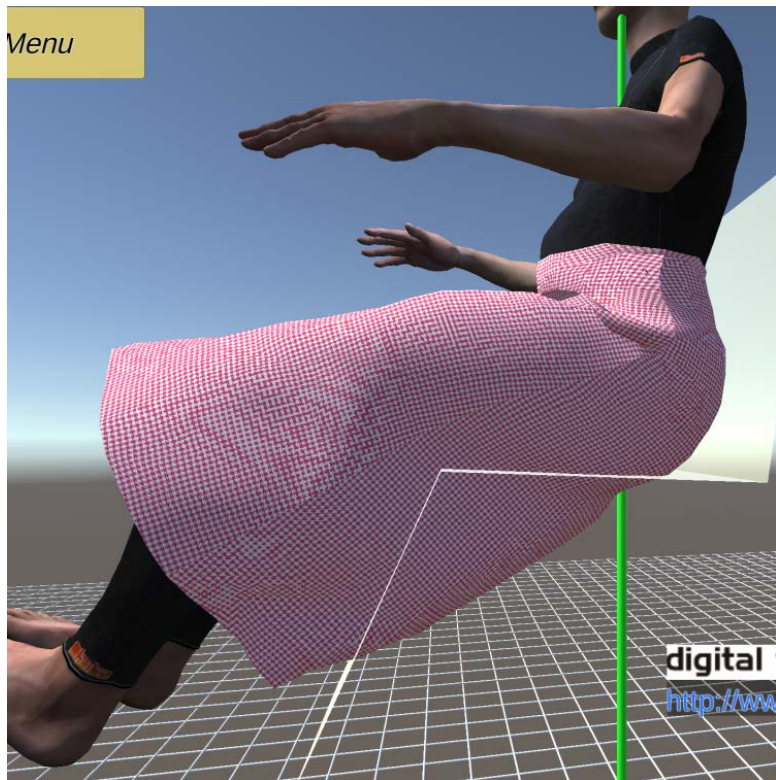
Results with normal pattern



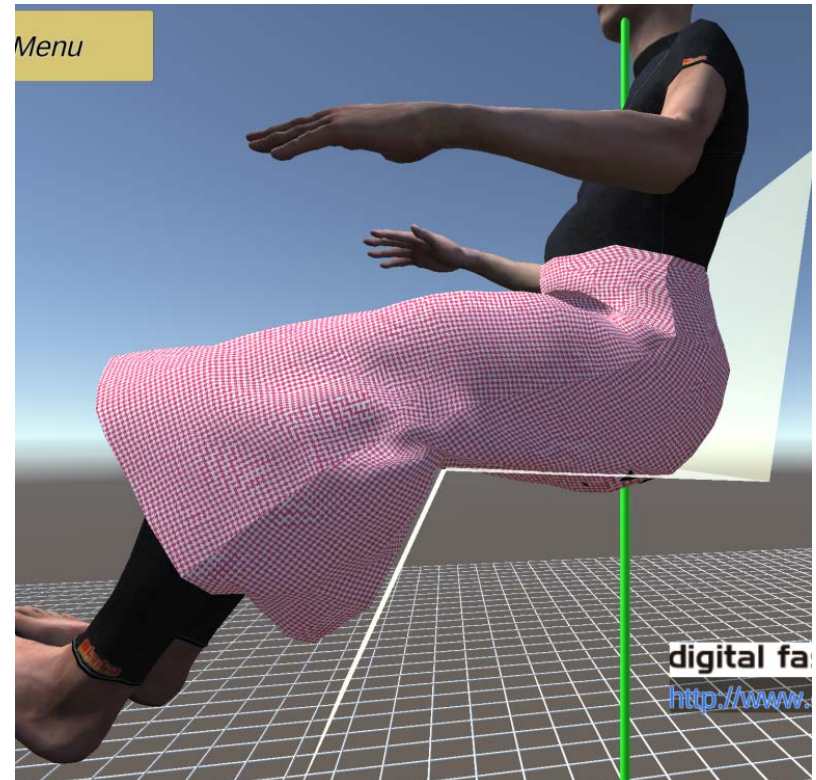
Results with dedicated pattern
for sitting position

Remarkable Result 2

- Comparison between with or without collision detection



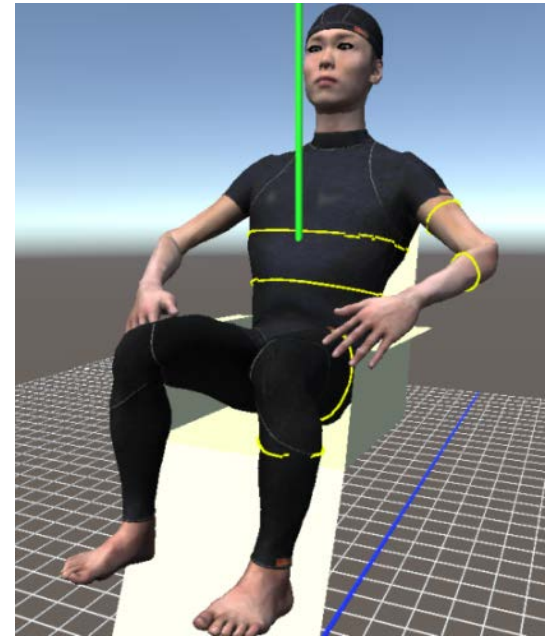
(a) Fitting without collision simulation with the seat



(b) Fitting with collision simulation with the seat

Numerical Evaluation

- Comparison between estimated lengths (yellow lines) and actually measured lengths of the chest girth, waist, thigh length
- Will gather more data of body after releasing the app.
 - Plan for holding the experiment for collecting the body data has been approved from AIST.



	Correct	Estimated
Chest girth	97 cm	98.8 cm
Waist	90 cm	86.3 cm
Thigh length	56 cm	53.3 cm

Conclusion & Future Works

- Proposed virtual fitting app for wheelchair users
 - The user can check fitting result they remain sitting on the wheelchair
 - The app can collect the body shape data, which are required for designing the garments for them.
- Future works
 - Releasing app.
 - Statistical analysis of the body data collected by the released app
 - Automation of the body pose and shape matching procedures (AI might be utilized for this)



Questions?

- Contact:
Ryosuke Ichikari, Ph.D.
r.ichikari@aist.go.jp
- This presentation is on Journal Track, you can download the draft paper from the CSUN web-site.