Body Measurement using a 2D Camera for Home Fitness

21900610 Soonho Lim

Supervisor : Prof. Youngkeun Kim

Introduction

- **Problem Statement:**
  - 3D body measurement systems are costly and impractical for home use.
- **Objective:**
  - Develop affordable and accessible alternative to traditional 3D systems.
- **Goal:**
  - Design and prototype a 2D-based human body measurement system.

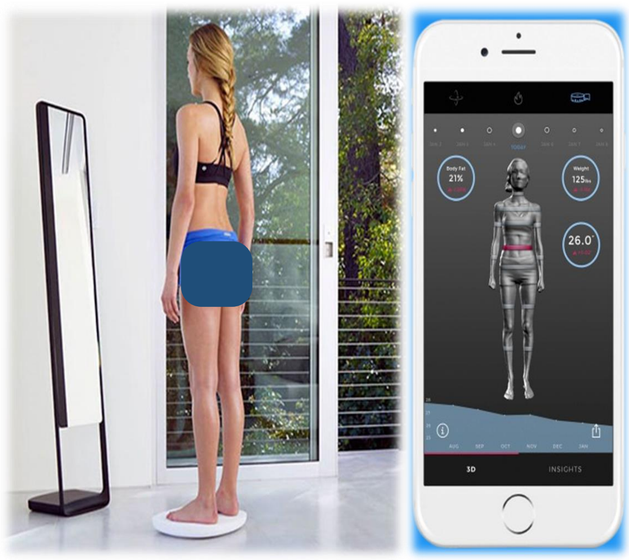
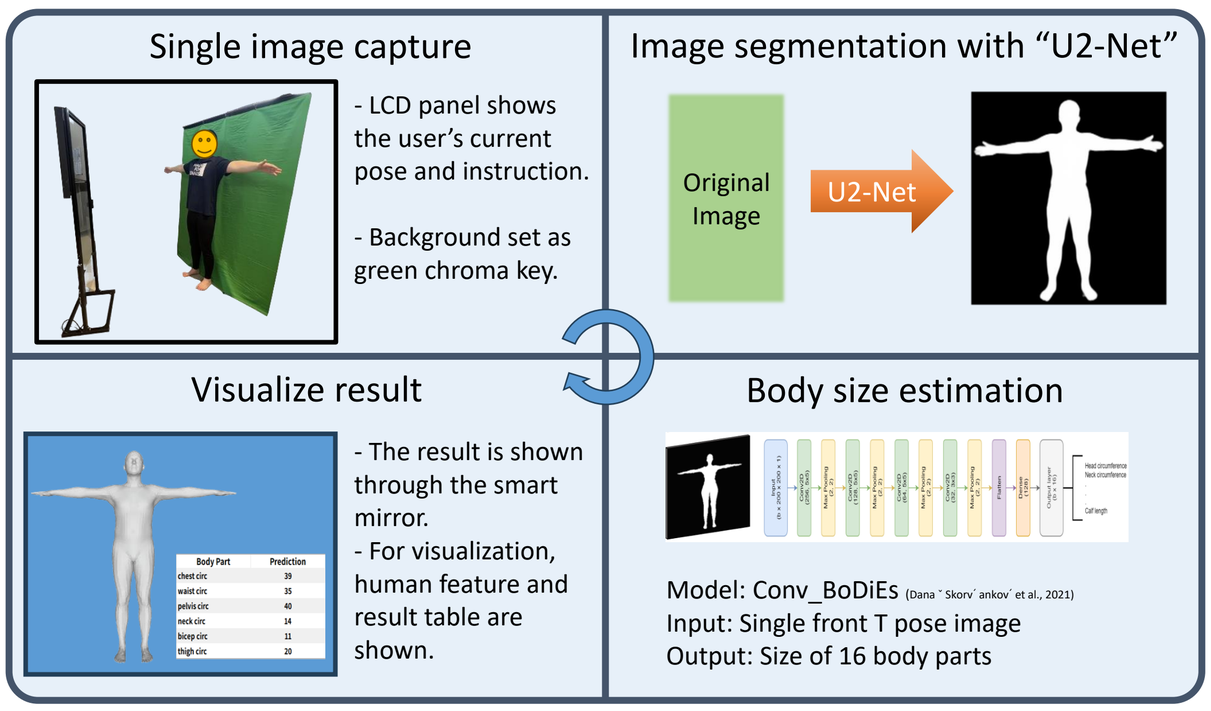


Fig 1. Aimed System Feature

Proposed system

- **Interact with the user with smart mirror**
- **16 body measurement estimation with single 2D image**
- **Visualization of results**



- **Conv_BoDiEs: Train Dataset & Evaluation**

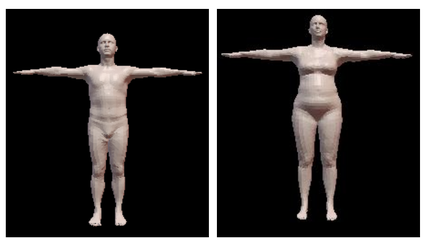


Fig 2. Sample Dataset

Body part	Test Data
chest circ	9.3
waist circ	8.8
pelvis circ	9.2
neck circ	5.8
⋮	⋮
MAE(total)	5.537[mm]

Table 1. Test Data Result

- **Model and Dataset**
  Conv_BoDiEs predicts 16 body measurements.
  50,000 *SMPL captured images are used for train and test.
- **Evaluation**
  The model achieved a 5.537[mm] MAE.

Hardware Design

Hardware designed like a mirror for "Home Fitness".

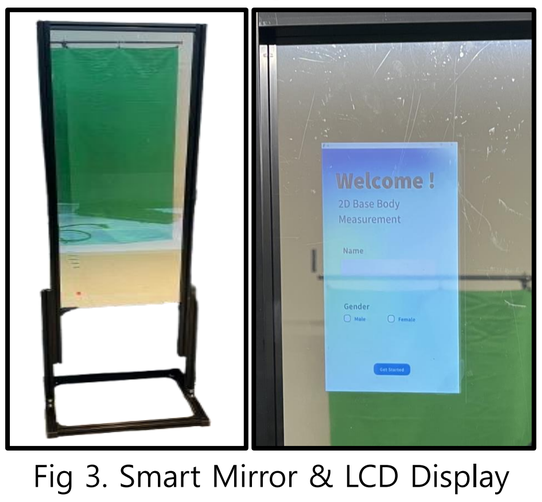


Fig 3. Smart Mirror & LCD Display

- **Hardware Specification:**
  Height: 175cm
  Width: 54cm
  LCD panel: 7inch (600x1024)
  Camera: 1090P web cam
  Film: half-mirror 35

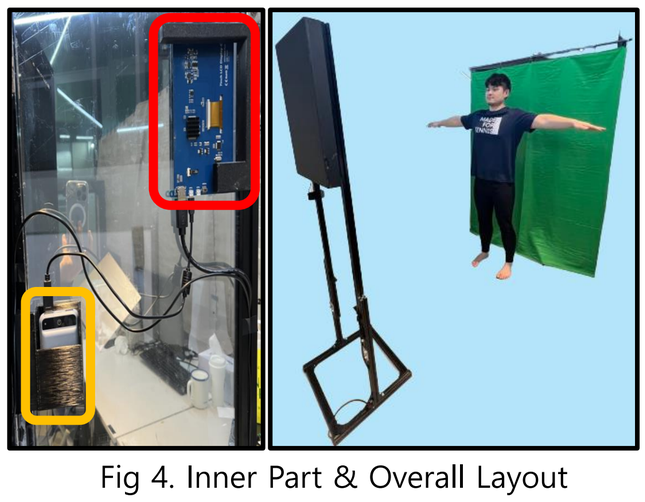
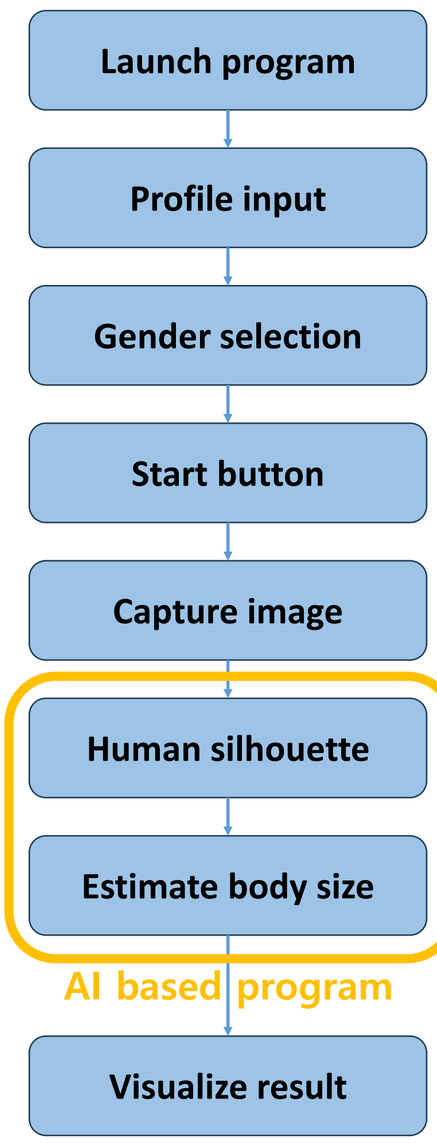
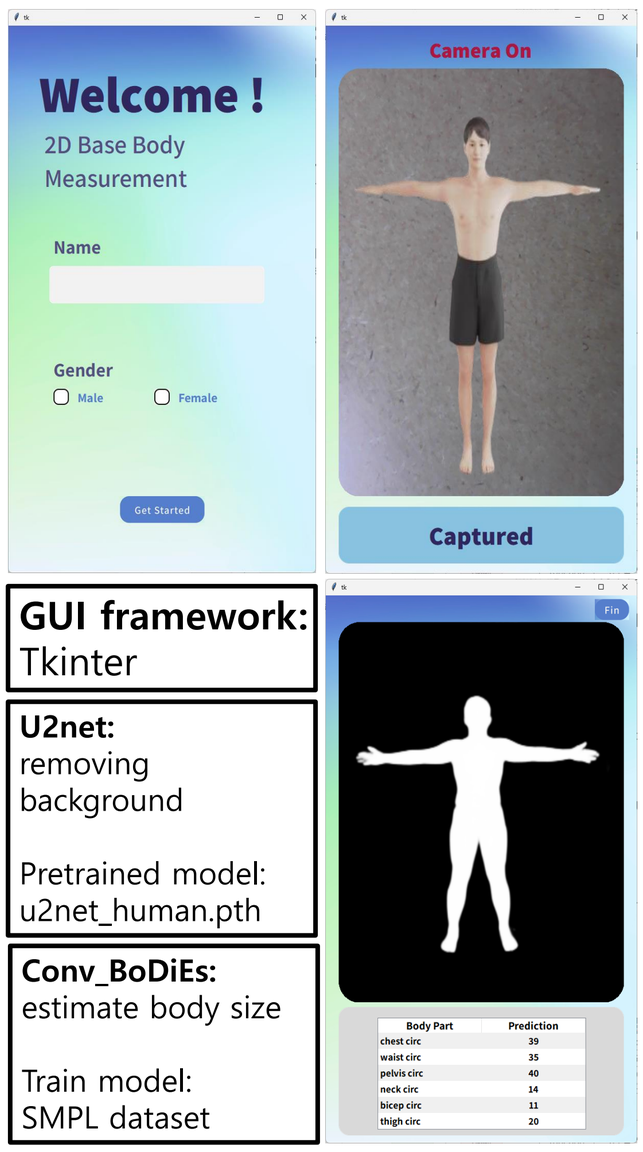


Fig 4. Inner Part & Overall Layout

- **Red Box:**
  LCD pannel with 3D printed holder
- **Orangd Box:**
  Barttery with 3D printed holder

GUI & System Flow





GUI framework:
Tkinter

U2net:
removing background

Pretrained model:
u2net_human.pth

Conv_BoDiEs:
estimate body size

Train model:
SMPL dataset

Fig 4. GUI

System Test

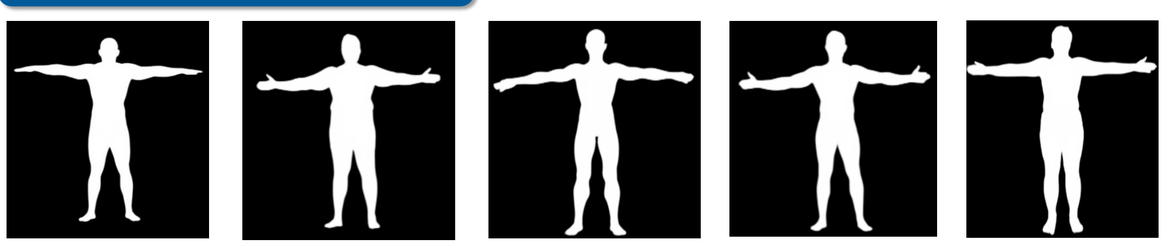


Fig 5. Test participant's silhouette

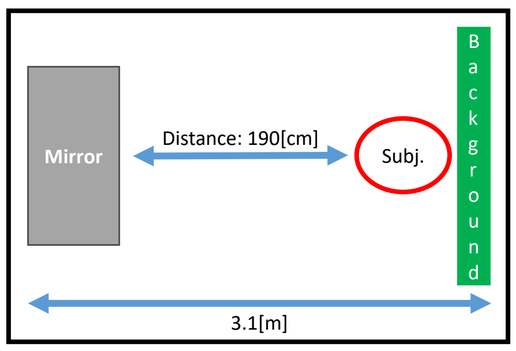
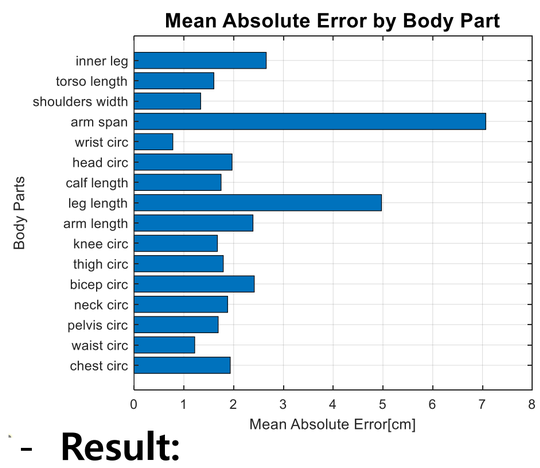
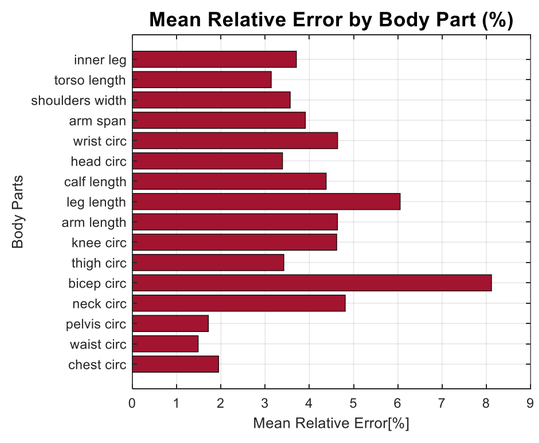


Fig 6. Test layout

- **Test participants:**
  10 male
- **Distance between camera and subject:**
  190[cm]
- **Overall space layout:**
  width – 3.1[m]
  length – 2.2[m]
  height – 2.5[m]

Result





- **Result:**
  Overall MAE: 2.3196[cm]
  arm span, bicep circumference and leg length has the worst result

Future Work

- **Visualize in 3D features**
- **Develop accuracy of the model**

Reference

[1] Škorvánková, Dana, Adam Riečický, and Martin Madaras. "Automatic estimation of anthropometric human body measurements." arXiv preprint arXiv:2112.11992 (2021).