

Biweekly Research Progress Report

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WBS : GUI완성 및 발표

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Research Results in This Biweek

기전융합프로젝트 포스터 발표:

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Body Measurement using a 2D Camera for Home Fitness

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.

Hardware

Hardware designed like a mirror for "Home Fitness"

Fig 7. Smart Mirror & LCD Display

Fig 8. Inner Part & Overall Layout

Hardware Specification:
Height: 175cm
Width: 54cm
LCD panel: 7inch (600x1024)
Camera: 1090P web cam

Red Box:
LCD pannel with 3D printed holder

Orange Box:
Barttery with 3D printed holder

Proposed System

Proposed System Process:

Single Image Capture → Body Segmentation Model → Body Size Estimation Model → Visualize Result

1. Single Image Capture:

LCD panel visualizes the user's current pose and instructions.

Background set with green chroma key for better image capture.

Fig 2. Capturing Image

2. Body Segmentation Model:

"U2-Net" highly accurate background segmentation model used for image processing.

Original Image → U2-Net → Segmented Image

Pretrained model: u2net_human_seg.pth

Fig 3. U2-Net

3. Body Size Estimation Model:

Model

Fig 4. Conv_BoDiEs Architecture

The model relies on a single 2D image for estimation, simplifies implementation

Model	Conv_BoDiEs
Input	Front T pose image
Output	Size of 16 body parts

Dataset & Test Evaluation

Fig 5. Sample Dataset

Body part	Test Data
chest circ	9.3
wast circ	8.8
pelvis circ	9.2
neck circ	8.6
MAE(total)	5.537(mm)

Dataset : 50,000 *SMPL captured images are used for train and test.

Evaluation : The model achieved a 5.537[mm] MAE.

4. Visualization Result:

The result is shown through the LCD placed back of the mirror.

For visualization, human feature and result table are shown.

Fig 6. Visualize Result

GUI

GUI framework- Tkinter

Fig 9. GUI Sequence

1. Type name for user result storage
2. Select gender for appropriate "trained model"
3. Results visualized in segmented image with table

Test

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]

Fig 10. 4 Sample of Test Participant

Result

Fig 11. 10 Other Body Parts

Result: Overall MAE: 2.3[cm]

Directions for Future Research: Enhancement of Accuracy, Visualizing in 3D model

Fig 11. Result of Interest Body Parts

Reference

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

[2] Loper, Matthew, et al. "SMPL: A skinned multi-person linear model." Seminal Graphics Papers: Pushing the Boundaries, Volume 2, 2023, 851-866.

[3] Qin, Xuelin, et al. "U2-Net: Going deeper with nested U-structure for salient object detection." Pattern recognition 106 (2020): 107404.