Lim[b]itless: Image Collection Software for Photogrammetry Modeling

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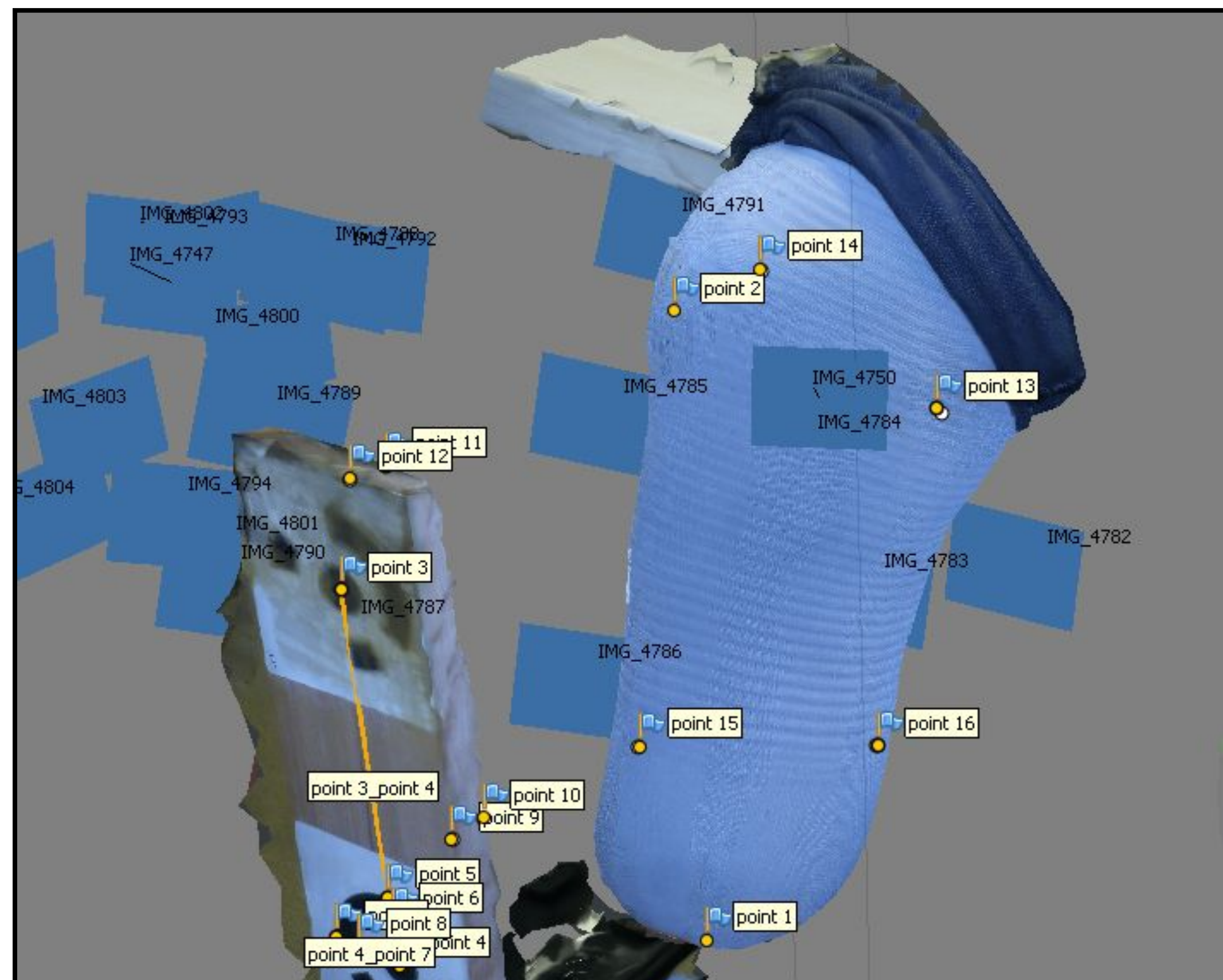University of California, San Diego*

Background

Our overall goal is to create low-cost 3D printed prosthetics, modeled from pictures of the amputee's residual limb. Our team's goal is to create an app to collect those pictures to simplify the process for the user. The app is Java based, built in Android Studios for Android devices. The models are made in Agisoft.

Example of model stitched from collected images in using Agisoft. [2]

Objectives

Create an app that can guide users to take, store, and send pictures to our database. We broke down our objective into three main areas of focus for each quarter:

Core Design:
- **Camera** (picture taking and saving)
- **Photo Album** (app UI construction)
- **User Guidance** (progress display design)

Advanced Functions:
- **Image Cleaning** (to generate accurate models)
- **Camera & Gyroscope** (angle increment facilitated burst mode)
- **Unit Testing & Integration** (modular coding & integrating completed parts)
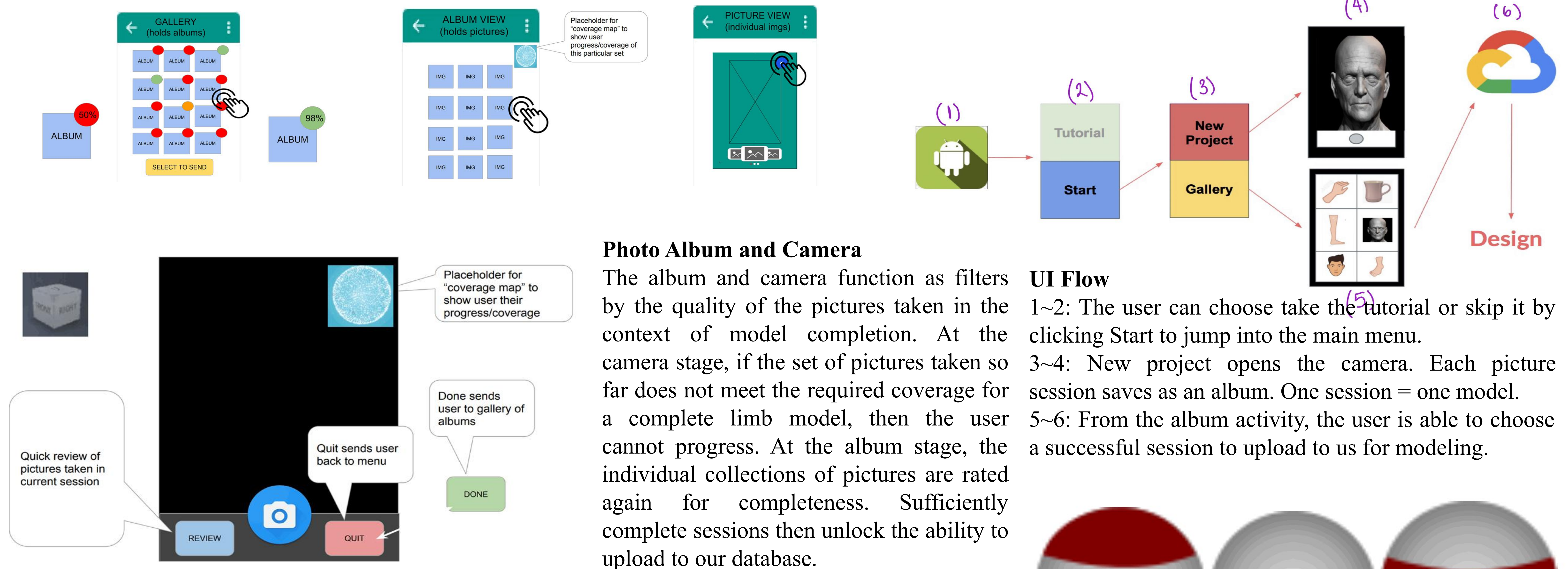
Core Design

Photo Album and Camera
The album and camera function as filters by the quality of the pictures taken in the context of model completion. At the camera stage, if the set of pictures taken so far does not meet the required coverage for a complete limb model, then the user cannot progress. At the album stage, the individual collections of pictures are rated again for completeness. Sufficiently complete sessions then unlock the ability to upload to our database.

UI Flow
1~2: The user can choose take the tutorial or skip it by clicking Start to jump into the main menu.
3~4: New project opens the camera. Each picture session saves as an album. One session = one model.
5~6: From the album activity, the user is able to choose a successful session to upload to us for modeling.
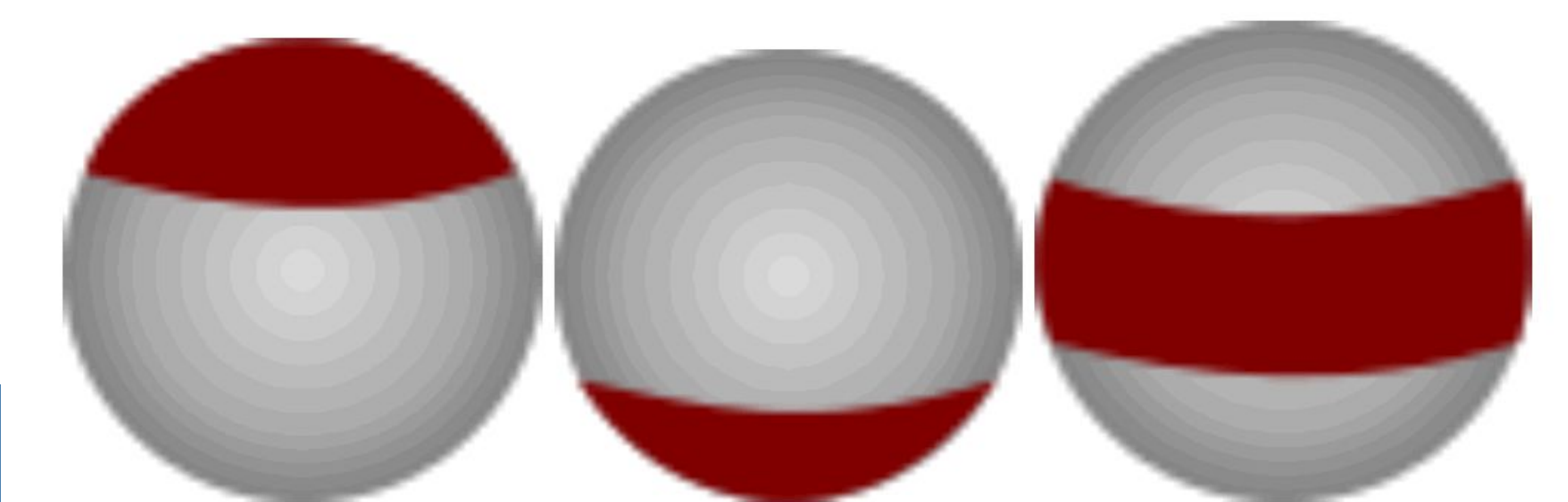
User Guidance:
Visualization of the user camera's angle of attack relative to the limb and of the user's coverage progress.
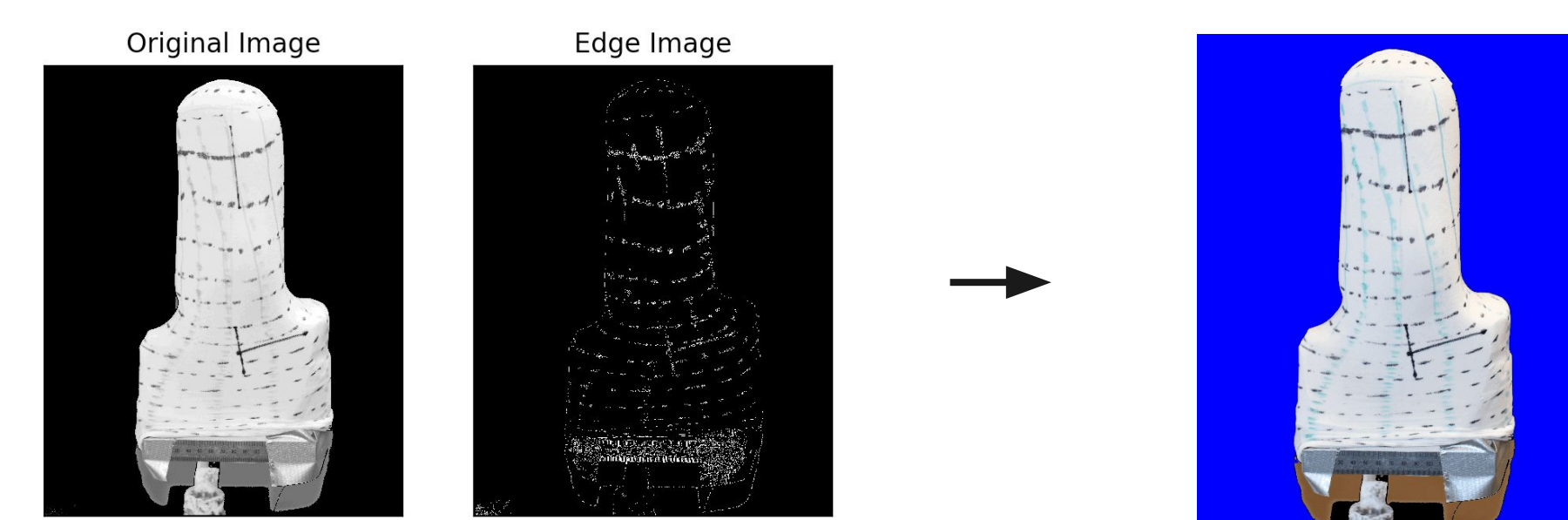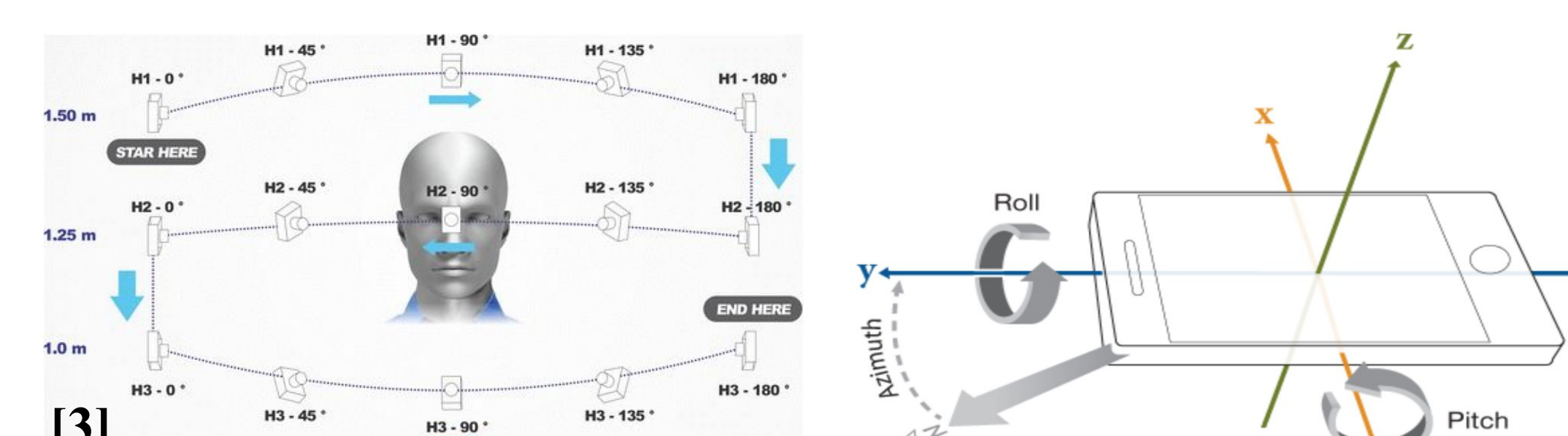
Advanced Functions

Image Cleaning:
To create accurate models of the residual limb, the background must be removed. However, photoshopping each picture is time intensive. Therefore, we resolved to use openCV, edge detection, mask creation, and mask to image merging to cut out the target limb image.

Camera & Gyroscope
To simplify the picture capturing process for the user, the camera captures a picture every x increment in phone orientation overall. Motion sensors are equipped in Android devices, including the rotation vector sensor which allow sus to track phone orientation.

Acknowledgements

References

[1] A. Hernandez and E. Lemaire, "A smartphone photogrammetry method for digitizing prosthetic socket interiors," Prosthet Orthot Int, vol. 41, no. 2, pp. 210–214, Apr. 2017.

[2] Isaac Cabrera et al., "Engineering Human Frontiers Towards 3D Printable Prosthetics," UC San Diego, La Jolla, Jun. 2018.

[3] R. Salazar-Gamarra, R. Seelaus, J. V. L. da Silva, A. M. da Silva, and L. L. Dib, "Monoscopic photogrammetry to obtain 3D models by a mobile device: a method for making facial prostheses," Journal of otolaryngology - head & neck surgery = Le Journal d'oto-rhino-laryngologie et de chirurgie cervico-faciale, vol. 45, no. 1, pp. 33–33, May 2016.