Estimating Finger Postures by Attaching an Omnidirectional Camera to the Center of a User's Palm

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Introduction

We present the method for estimating the natural postures of a user's fingers from the images captured by an omnidirectional video camera attached to the center of the user's palm in real time. The finger postures can be estimated by detecting the fingertips on each image and referring to the following preset information: the positional relationship between the camera and the user's fingers/fingertips, the length between the finger joints, and the interdependencies between the finger joints.
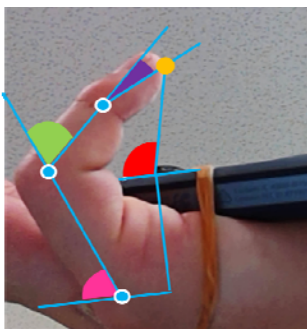
Our idea for finger postures reconstruction is in the following:
1. Detect fingertips from an image captured by the camera.
2. Calculate the angle between the vector from the lens to each fingertip and camera body.
3. Estimate finger postures from the angle based on inverse kinematics by referring to the interdependencies between the finger joints when fingers are moved naturally.
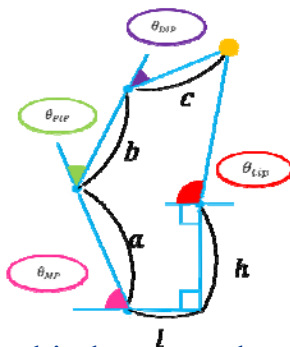

Detection of fingertips

The θ_{tip} of each finger is calculated from the fingertip pixel with a fish-eye lens projection model and thus, the joint angles (θ_{MP}, θ_{PIP}, θ_{DIP}) can be calculated based on inverse kinematics by referring to the movable range and the interdependencies of the finger joints.

The positional relationship between the camera and the fingers

Reconstruction of finger postures
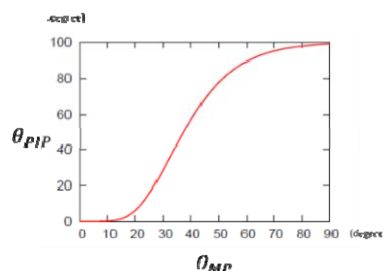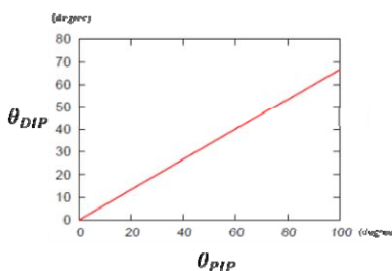
The dependencies of each joint angle

Reference
- Fujiki R., Arita D., Taniguchi R. 2005. Real-Time 3D Hand Shape Estimation Based on Inverse Kinematics and Physical Constraints. In: Roli F., Vitulano S. (eds) Image Analysis and Processing – ICIAP 2005. ICIAP 2005. Lecture Notes in Computer Science, 3617. Springer, Berlin, Heidelberg.

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