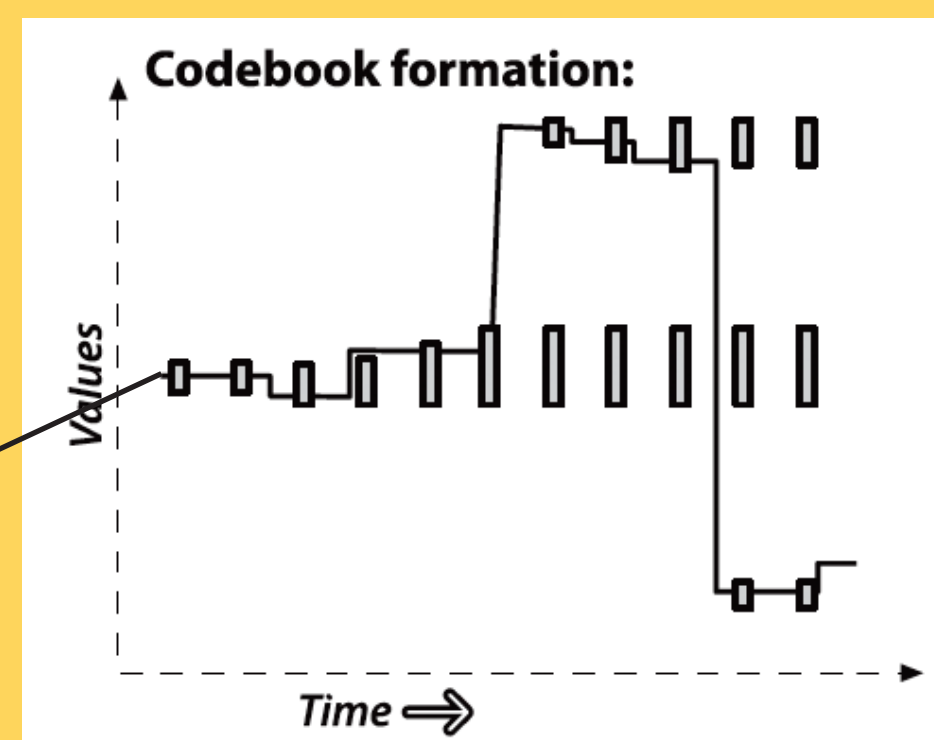


Hand Tracking and Gesture Recognition Using Echo State Neural Networks

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Foreground Segmentation (YCbCr)



- Foreground is segmented from background model.
- Model keeps codebook information of every pixel and channel.

Color filter and skin region detection



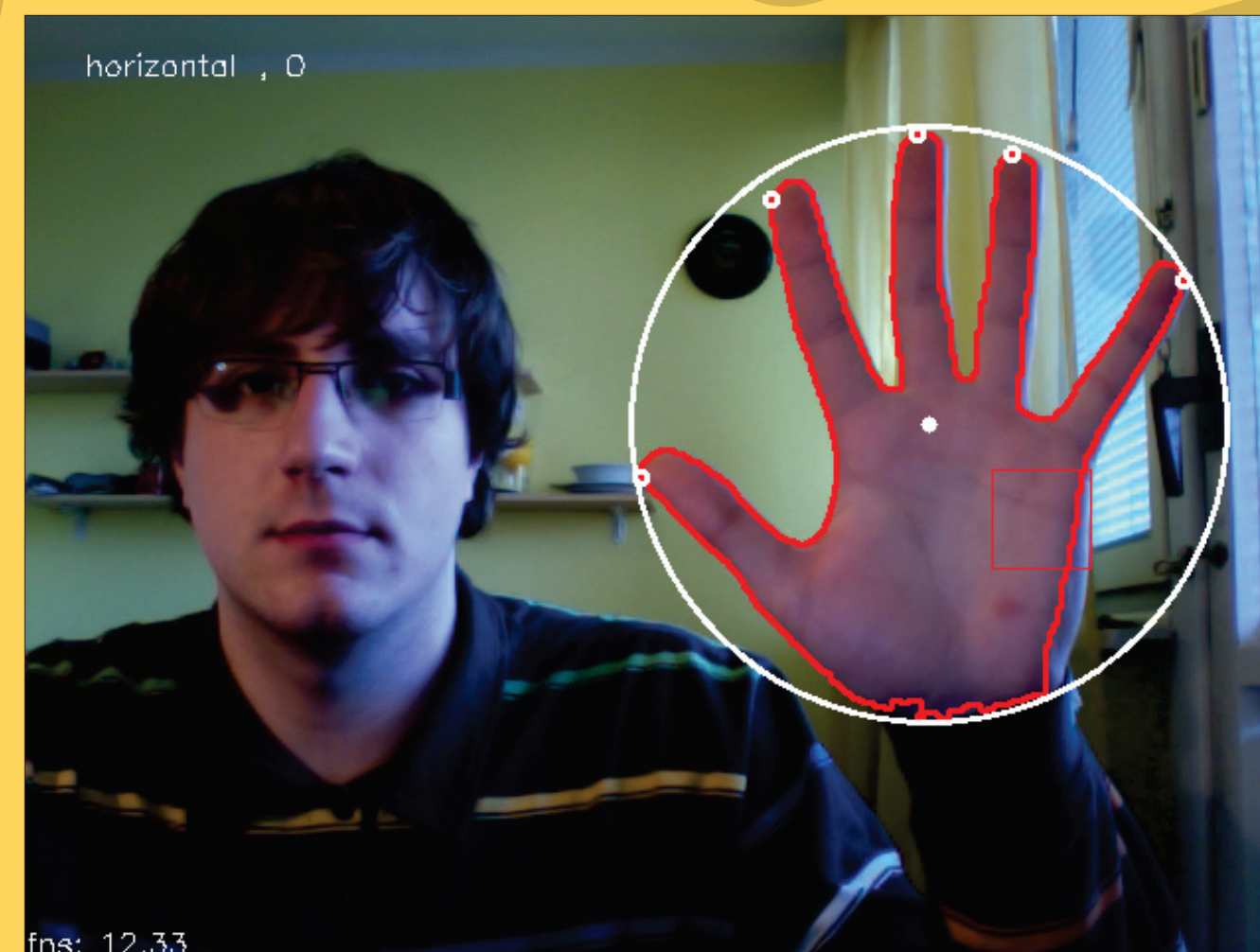
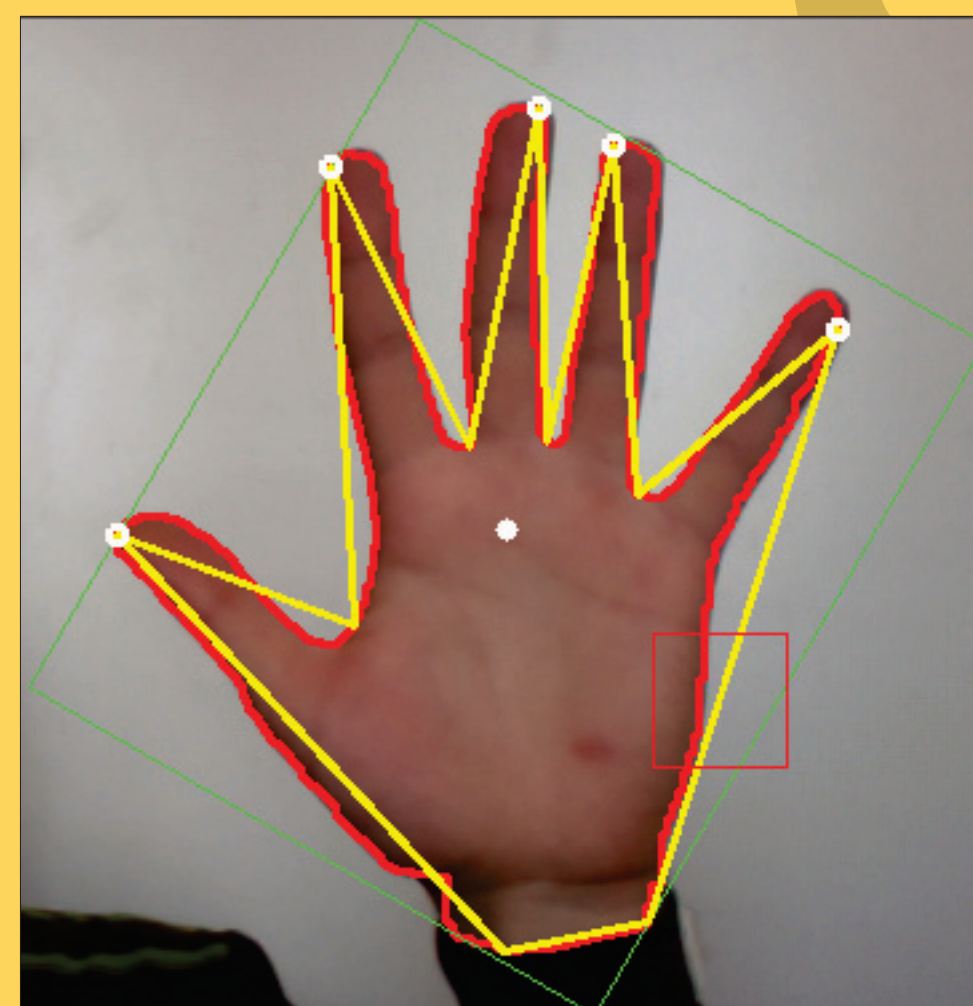
- The color filter segments an image according to ranges of saturation and value (lightness).



$$pdf(x, y) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(hue(x, y) - \mu)^2}{2\sigma^2}}$$

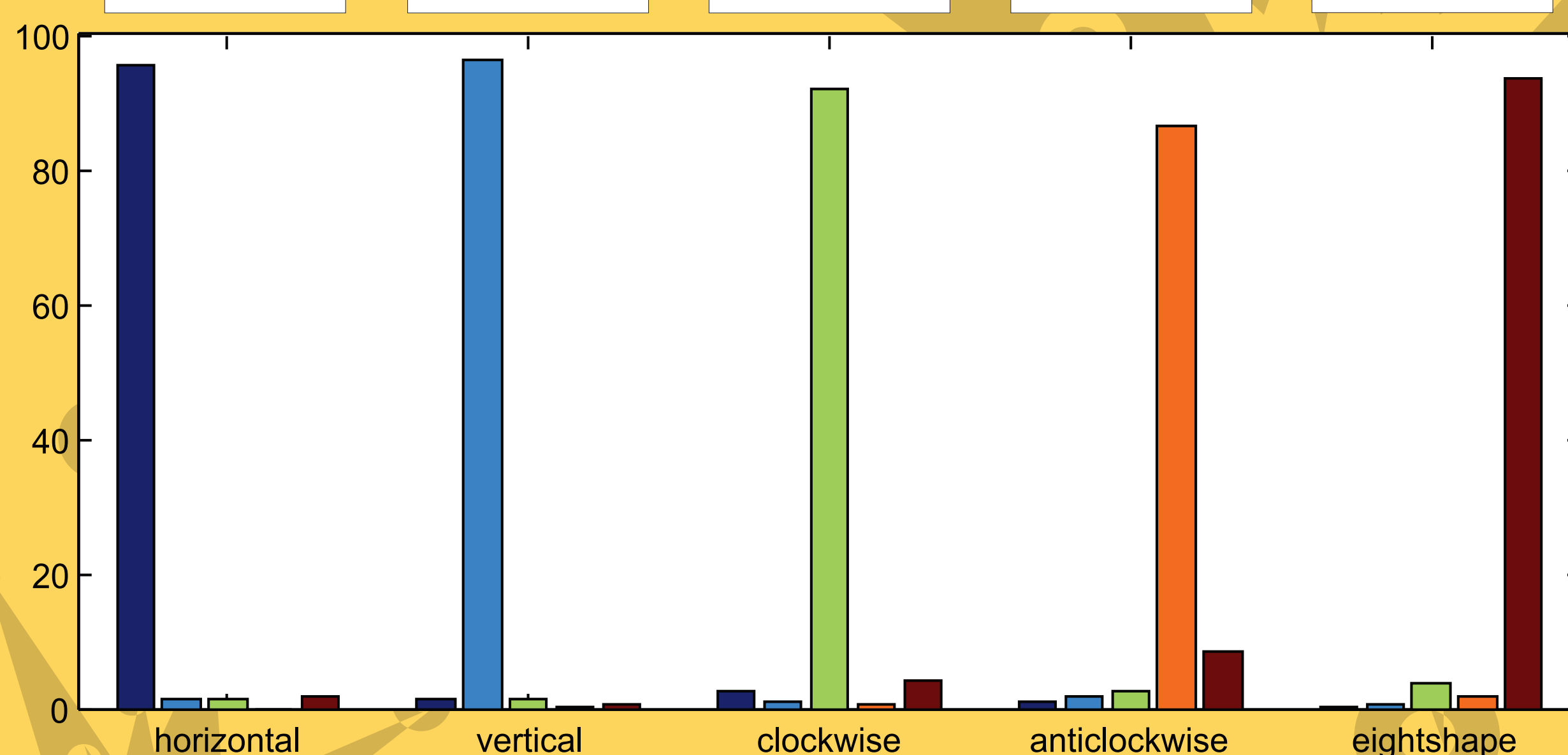
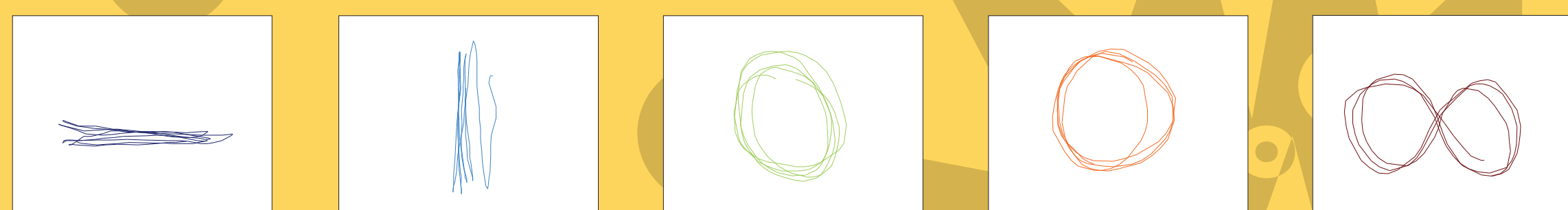
- Skin region detector find color of tracking object in image by probability density function.

Features extraction



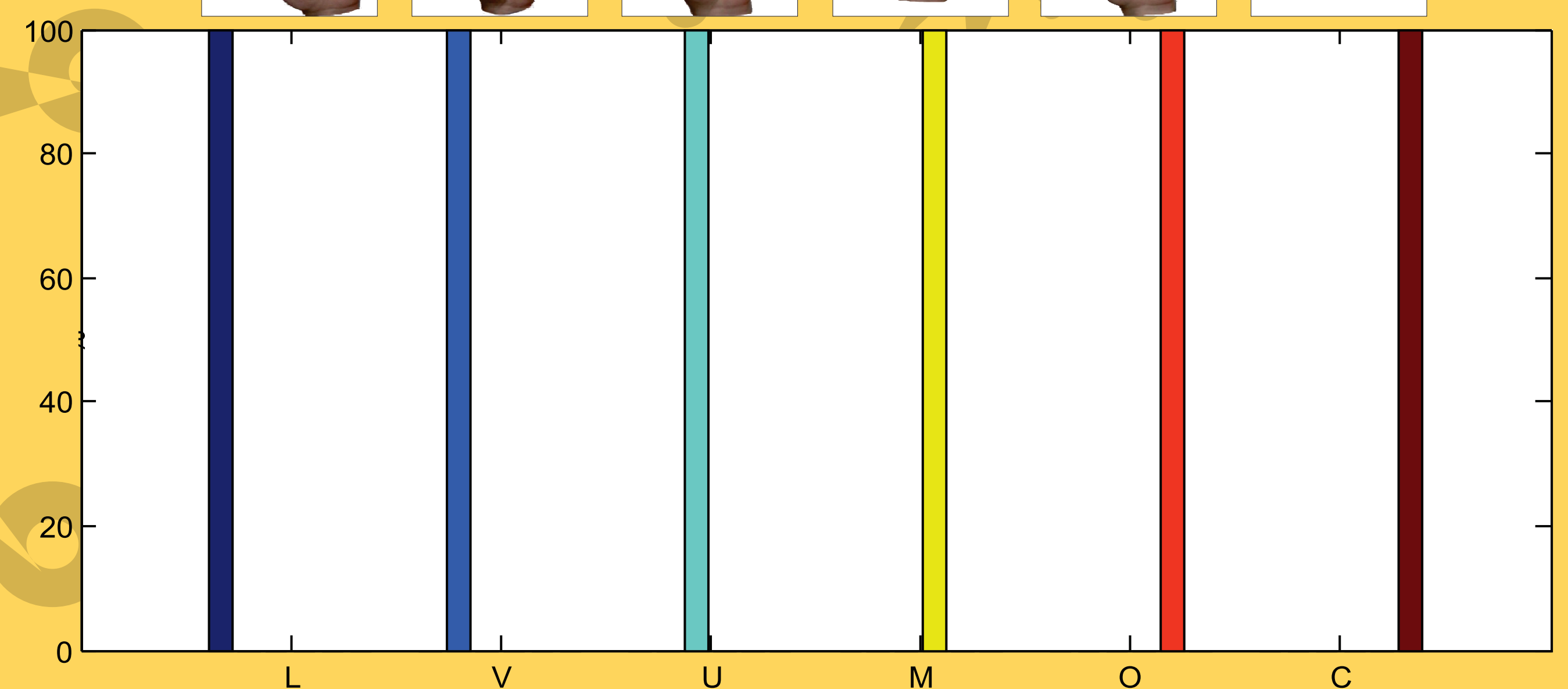
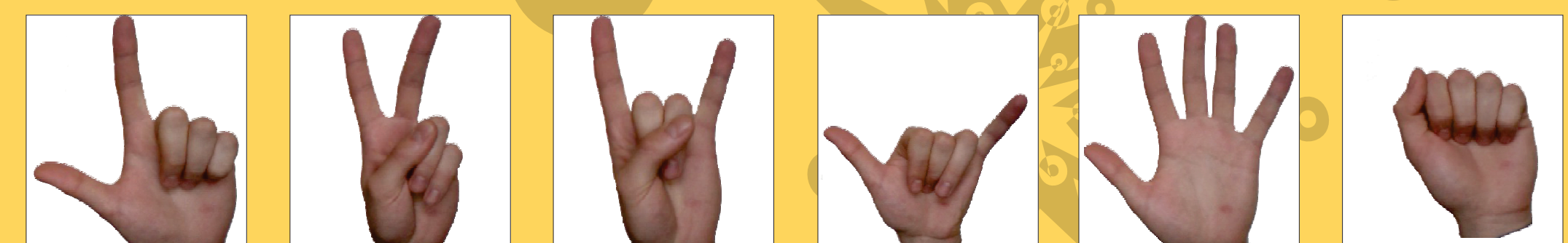
- Hand tips detection based on dominant points, angle between them and distance from center.
- Hand model = (center, radius, angle, fingers, ratio, hu_moments)
- Real time processing and gesture recognition at rate 8-14fps.
- Images were captured using web camera with 640 by 480 resolution.
- Whole algorithm was implemented in C/C++ using OpenCv.

Gesture Recognizer (92,72 %)



- Data set was 250 samples (50 for each gesture).
- ESN with DR of 1000 neurons has been used.

Hand Pose Recognizer (100%)



- Data set was 3500 samples (approximately 500 of each pose).
- FFNN with only 10 hidden neurons was used.