XKin - eXtendable hand pose and gesture recognition library for Kinect

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Outline

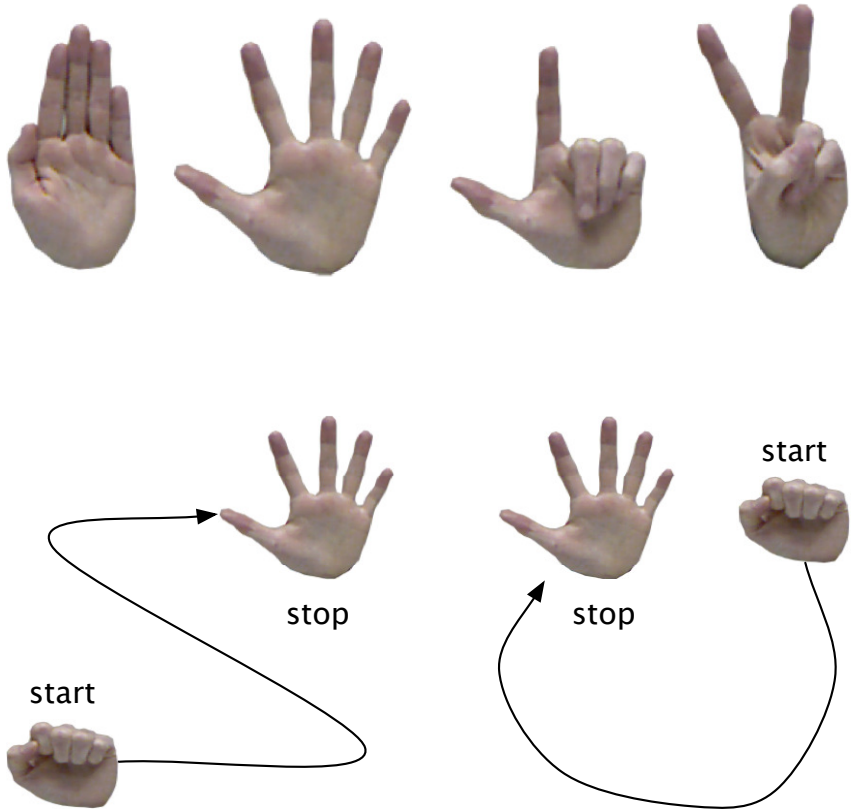
```
// include stuff

int main(int argc, char** argv)
{
  IplImage *rgb, *depth, *body, *hand;
  CvPostModel *models;
  CvSeq *cnt;
  CvPoint cent;
  int z, num, p;

  for (;;) {

    // kinect data acquisition -> rgb, depth

    body = body_detection(depth);
    hand = hand_detection(body, &z);

    if (!get_hand_contour_advanced(hand, rgb, z, &cnt, &cent))
      continue;

    p = advanced_posture_classification(cnt, models, num));

    // draw stuff

  }

  // release stuff

  return 0;
}
```

Gesture Recognition

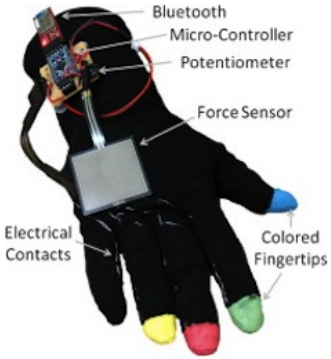
- Understand the meaning of body movements
  - Go, Stop, Come here
  - Hello
  - Look at
  - ...
- Key aspect in the design of efficient and powerful Human Computer Interaction systems
- Wide range of applications
  - Medical
  - Domotics
  - Videogames

Hand Gesture

- Most important kind of gestures
  - example of the expressive power of hands: sign languages
- Two types:
  - pose: *static* meaning (different hand shape)
  - gesture: *dynamic* meaning (different hand movement)



RGB-D Approach to Gesture Recognition



- Weakness of the classic (RGB) computer vision algorithms
- Encumbrance of wearing special device
- Impossibility to realize *natural* and robust system for real time applications
- Kinect sensor
  - Low cost
  - Color + depth information
  - Enable the development of more powerful algorithms

Solutions Overview

	License	Functionality	
		Low level [1]	High level
Libfreenect	open	yes	no
OpenNI/PrimeSense	open	yes	no
NiTE	closed	no	skeleton hand point gesture scene
Microsoft Kinect SDK	closed	yes	skeleton

[1] Raw data acquisition

Solutions Overview

Proposed solution

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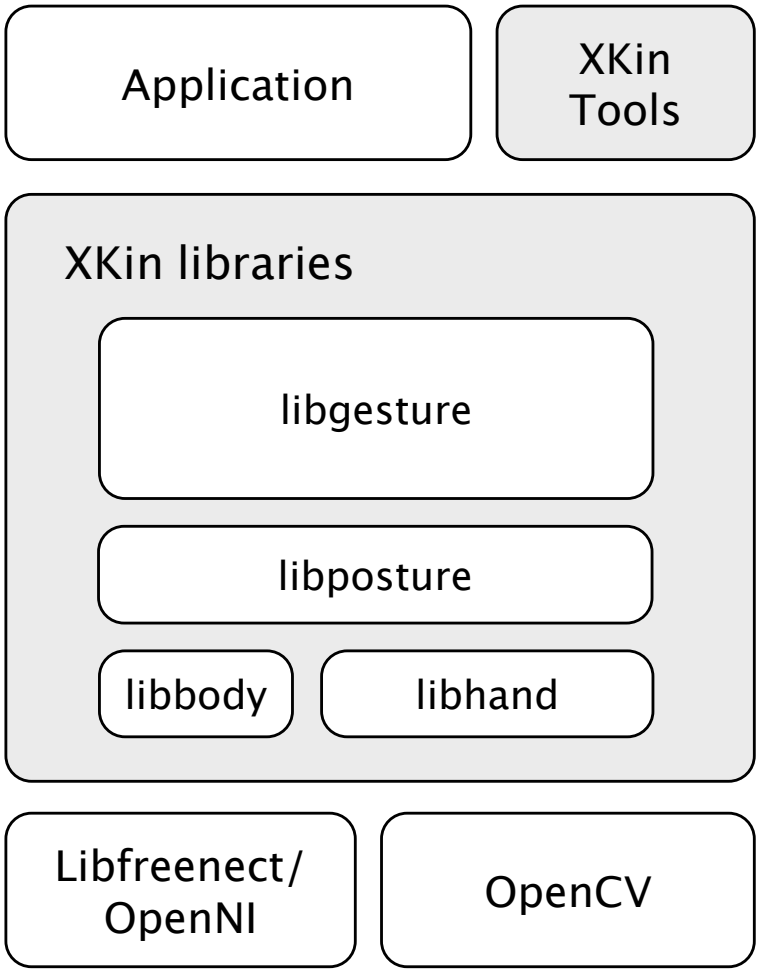
[1] Raw data acquisition

Proposed Solution

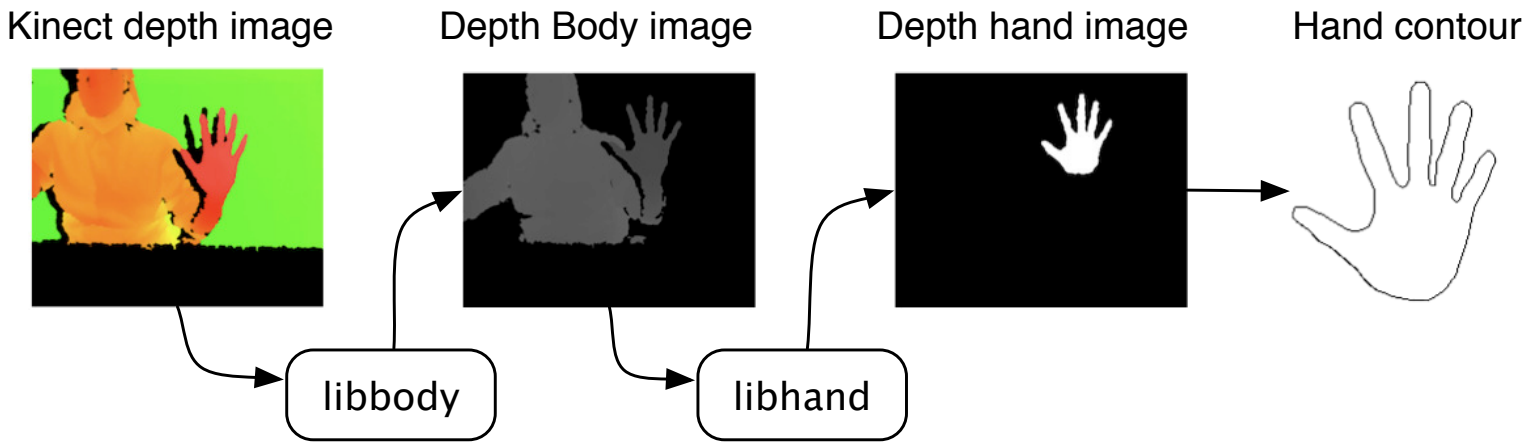
- Open source set of libraries specifically designed for hand gesture recognition
  - Written in C programming language (efficiency)
  - Modular design (expandability)
  - Available at `https://github.com/fpeder/XKin.git` under BSD license
- Complete solution
  - hand-pose
  - hand-gesture
- Kinect (RGB-D approach)
- Real-time application

Architecture



- Dependencies
  - libfreenect: Kinect data acquisition
  - OpenCV: digital images, algorithms
- Hierarchical organization of libraries
- Tools for training and testing
- Simple application examples (demo)

Preprocessing Libraries



libbody

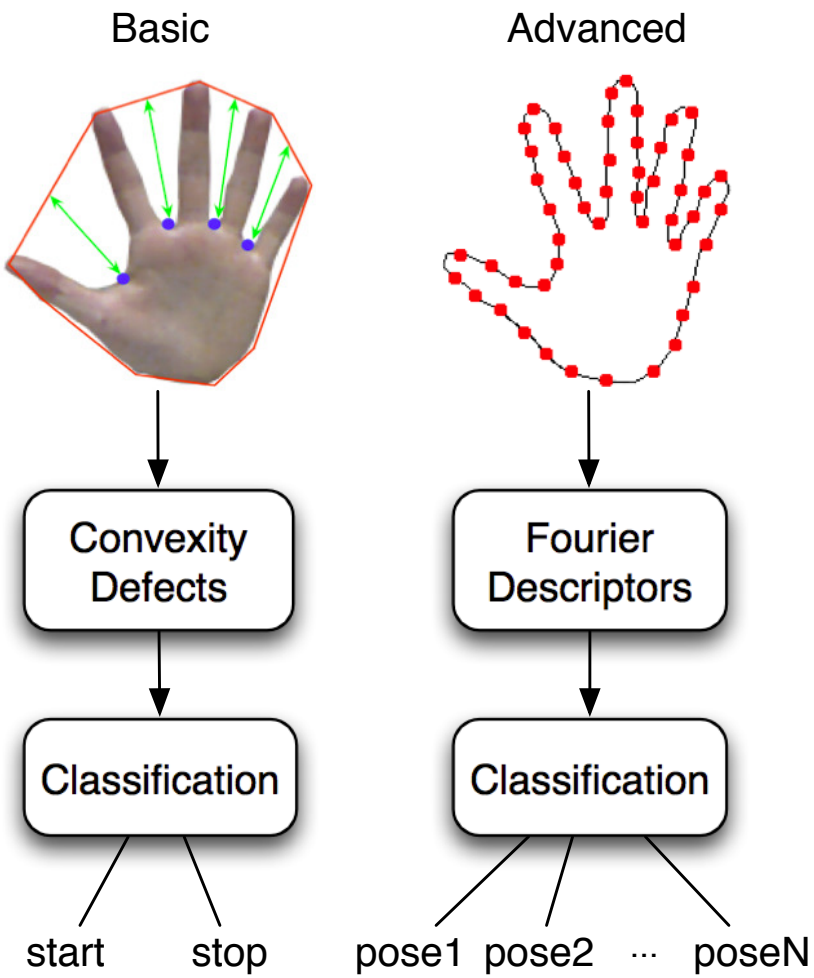
Body detection in the depth image

libhand

Hand detection and contour extraction:

- Rough computed in depth image (basic contour)
- Precise using depth+RGB procedure (advanced contour)

Recognition Libraries

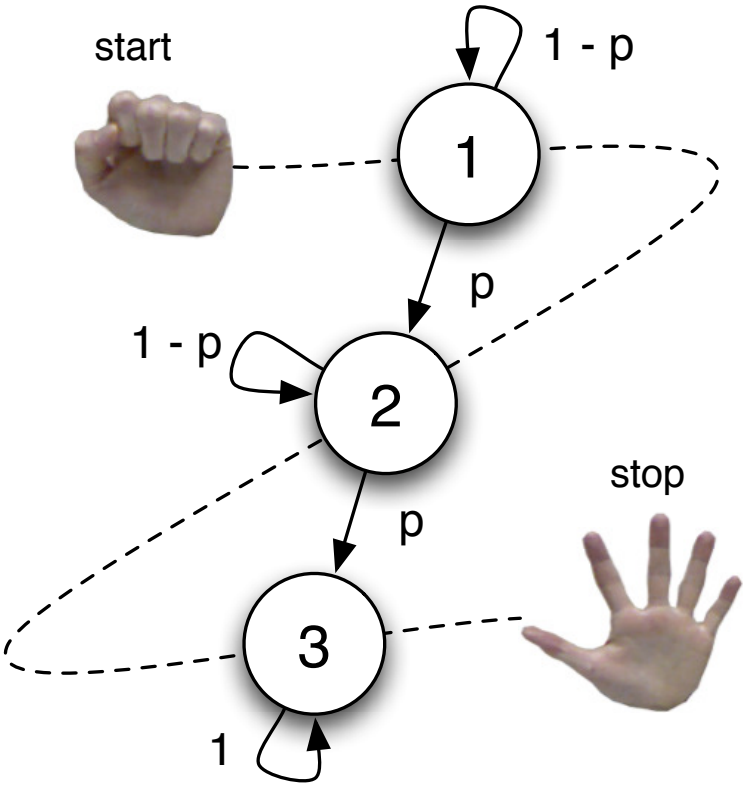


libposture

Hand posture classification

- start/stop, extremely robust (basic contour)
- More poses, less robust (advanced contour)

Recognition Libraries



libgesture

Hand gesture classification

- HMM matrix oriented lib
- State machine to extract gesture sequence
- Expectation-Maximization to train models
- Log-likelihood estimation to classify gestures

Rock-Scissor-Paper Game

loading...

Image Gallery Browsing

loading...

Conclusion and Future Work

- Complete open source package for hand gesture recognition
  - Novel in open source community
  - Solution to an aspect not even provided by closed software companies
- Good performance, despite young stage
- Fast and easy to use API for creating gesture-based applications
- What is next:
  - Enrich the set of functionality
  - Improve automatic hand-gesture segmentation