TOOLKIT SUPPORT FOR GESTURAL INPUT TECHNIQUES

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What is a gesture?

- “A gesture is a motion of the body that contains information. Waving goodbye is a gesture. Pressing a key on a keyboard is not a gesture because the motion of a finger on its way to hitting a key is neither observed nor significant. All that matters is which key was pressed”.

  - Kurtenbach and Hulteen (1990)

What is gesture recognition?

- A topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms.
- Can originate from body motion, but mostly associated with movement of the hand

Our obsession/fantasy with gestural inputs as seen in movies:

- Iron Man
- Minority Report

Benefit of gestural based interfaces

- Higher degree of freedom
- Natural to humans compared to traditional GUI
- Control or interact with devices without physically touching them
- A way for computers to understand our language – bridging human and machine interactions
- Faster/easier interaction: example – slide to unlock smart phones

Major application areas of gesture recognition currently trending

- Automotive sector
- Consumer Electronics sector
- Transit sector
- Gaming sector

Gesture types:

- Offline gestures: Those gestures that are processed after the user interaction with the object. An example is the gesture to activate a menu.
- Online gestures: Direct manipulation gestures. They are used to scale or rotate a tangible object.

Gesture types:

- Offline gestures: A $1 Recognizer
- Online gestures: Smartphones, 3D gestural recognition

Gestures without Libraries, Toolkits or Training: A $1 Recognizer for User Interface Prototypes

- Created by students and researcher at University of Washington and Microsoft
- 2-D single-stroke recognizer designed for rapid prototyping of gesture-based user interfaces
- Wanted to offer tool for rapid prototyping in design oriented environment
- present a “$1 recognizer” that is easy, cheap, and usable almost anywhere in about 100 lines of code.

$1 Goals

- be resilient to variations in sampling due to movement speed or sensing
- support optional and configurable rotation, scale, and position invariance;
- require no advanced mathematical techniques (e.g.,matrix inversions, derivatives, integrals);
- be easily written in few lines of code;
- be fast enough for interactive purposes (no lag);
- allow developers and application end-users to “teach” it new gestures with only one example;

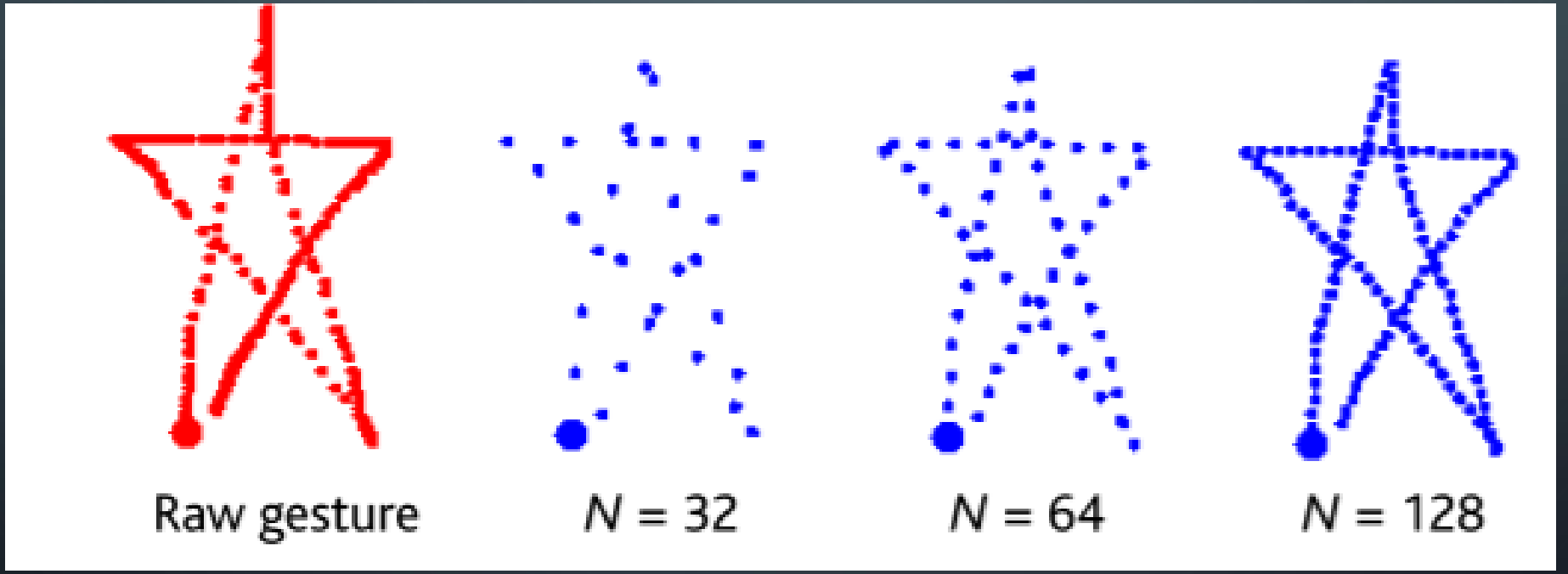
$1 $1 $1

- http://depts.washington.edu/madlab/proj/dollar/index.html

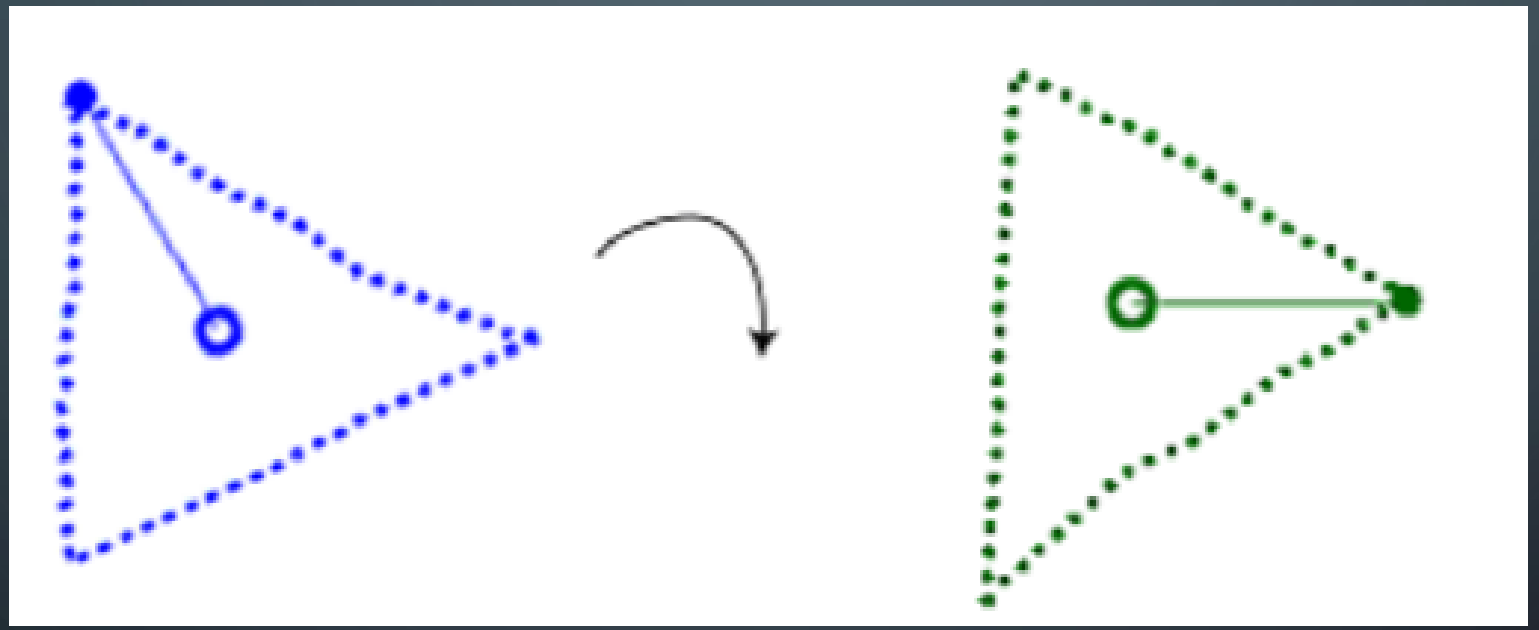
$1 – four step algorithm

- 1. Resample
- 2. rotate once
- 3. scaled and translate
- 4. Find optimal angle for the best score

Step 1: resample



Step 2: rotate once



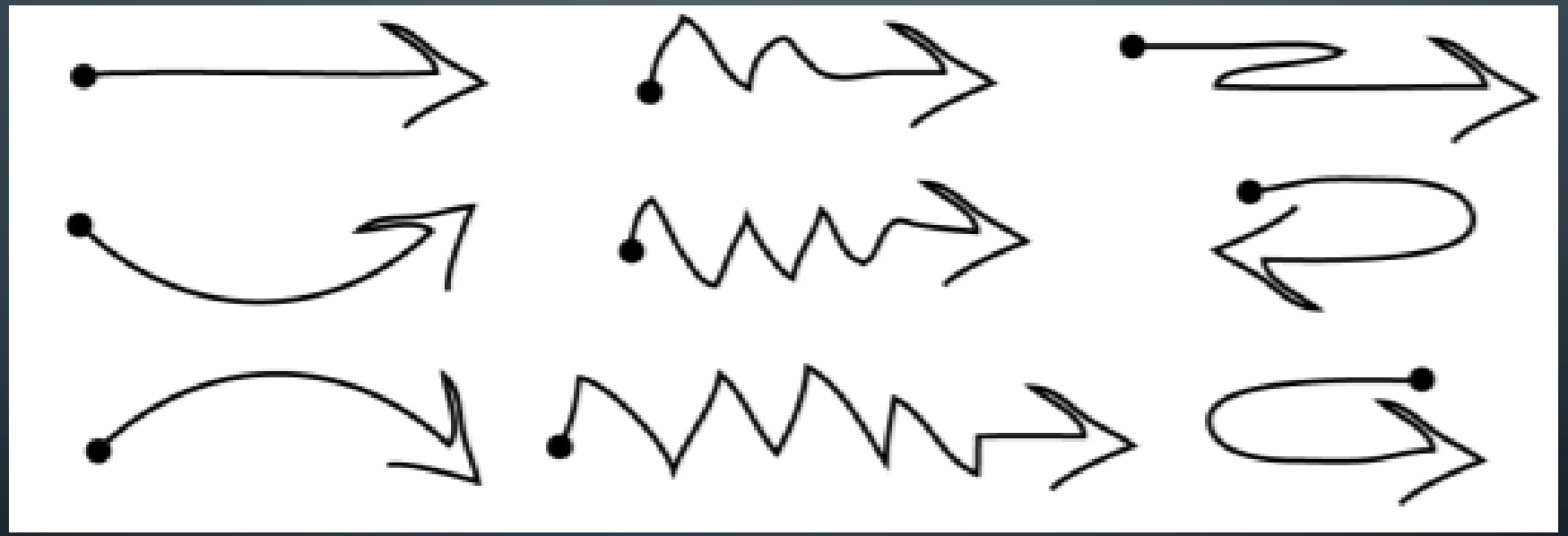
Step 3: scale and translate

- scaled to a reference square.

Step 4: Find Optimal Angle for the Best Score

- Recognition based on pre-defined shapes

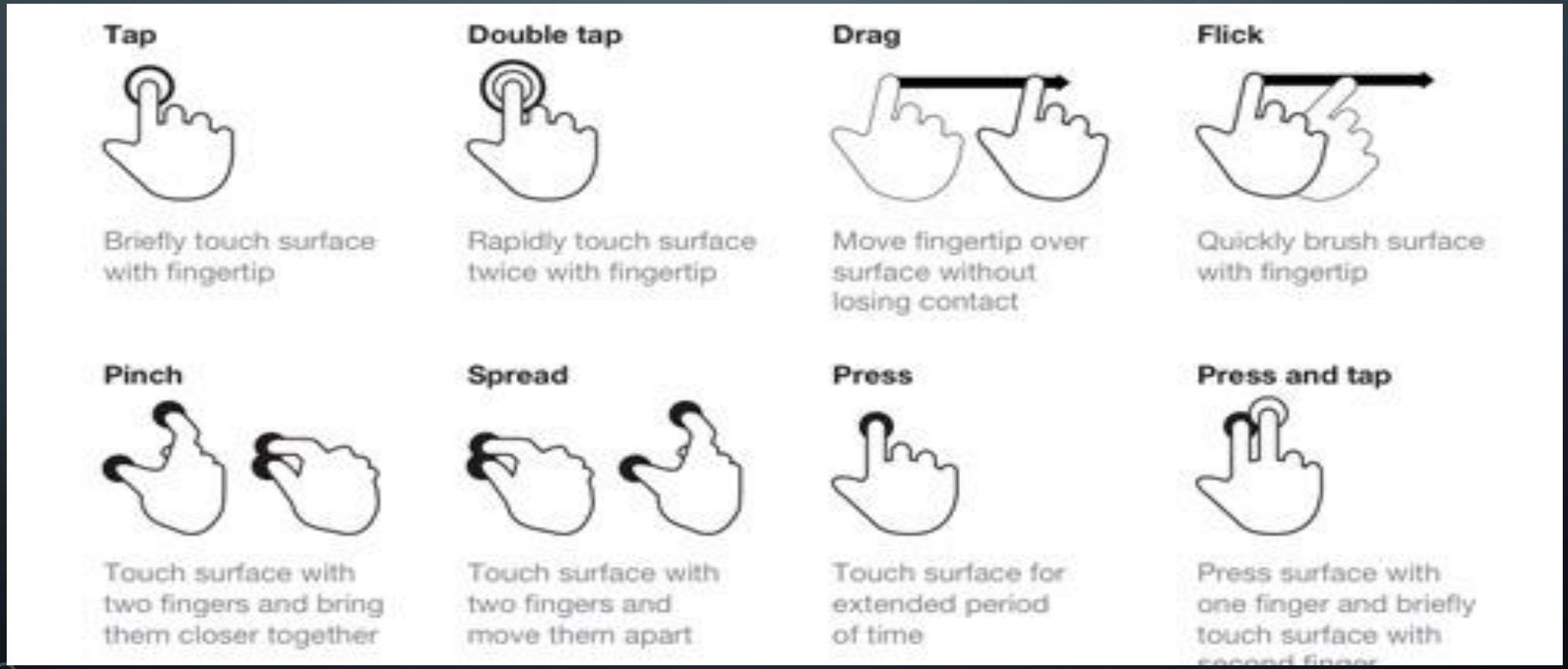
Defining Multiple Instances



Limitations

- recognizer is a geometric template matcher
- cannot distinguish gestures whose identities depend on specific orientations, aspect ratios, or locations. For example, separating squares from rectangles, circles from ovals, or up-arrows from down-arrows is not possible without modifying the algorithm.
- does not use time, so gestures cannot be differentiated on the basis of speed

Online gestures: Smartphones



Gestures on the IOS

- Apple provides sets of HCI guidelines and standards for reference and best practice
- https://developer.apple.com/ios/human-interface-guidelines/interaction/gestures/

Gestures on the IOS

- Apple provides framework called UIKit
- UIKit responds to user interactions and system events, access various device features, enable accessibility, and work with animations, text, and images.

Gestures on the IOS

- The UIGestureRecognizer class as an abstract class
- Series of sub classes for common gestures…
  - UITapGestureRecognizer
  - UISwipeGestureRecognizer
  - UIPanGestureRecognizer
  - UIPinchGestureRecognizer:
  - UIRotationGestureRecognizer
  - UILongPressGestureRecognizer
  - UIScreenEdgePanGestureRecognizer

Gestures on the IOS

```
override func viewDidLoad() {
    super.viewDidLoad()

    let gestureRecognizer = UITapGestureRecognizer(target: self, action: "handleTap:")
    self.view.addGestureRecognizer(gestureRecognizer)
}

func handleTap(gestureRecognizer: UIGestureRecognizer) {
    let alertController = UIAlertController(title: nil, message: "You tapped at \(gestureRecognizer.locationInView(self.
view))", preferredStyle: .Alert)
    alertController.addAction(UIAlertAction(title: "Dismiss", style: .Cancel, handler: { _ in }))
    self.presentViewController(alertController, animated: true, completion: nil)
}
```

Gestures on the Android

- Similar to IOS, Android provides GestureDetector class for detecting common gestures.
- Some of the gestures it supports include onDown(), onLongPress(), onFling(), and so on.
- You can use GestureDetector in conjunction with the onTouchEvent() method for event handling

3D gesture handling

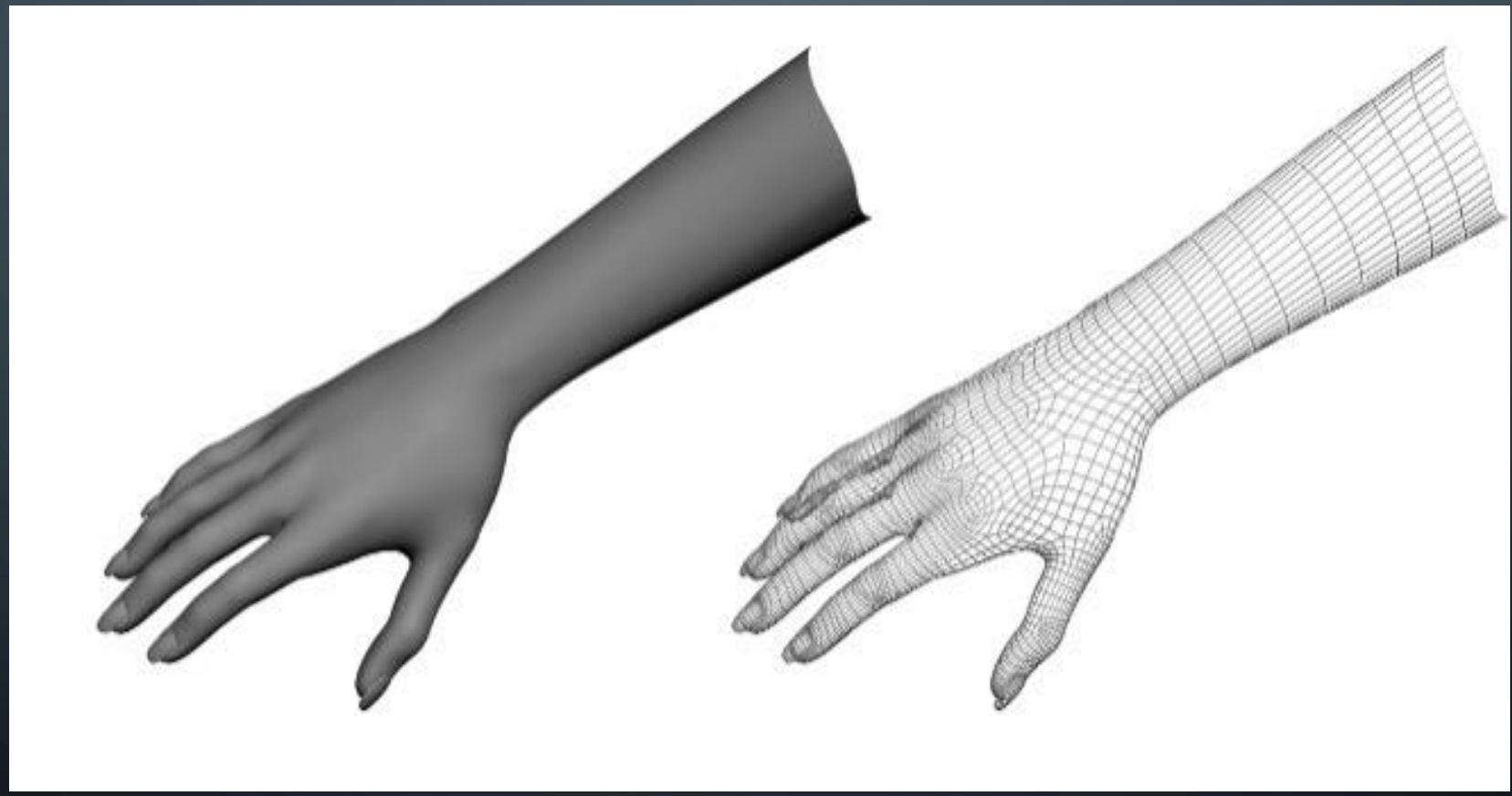
3D gesture handling - inputs

- The kinetic user interfaces (KUIs) are an emerging type of user interfaces that allow users to interact with computing devices through the motion of objects and bodies.

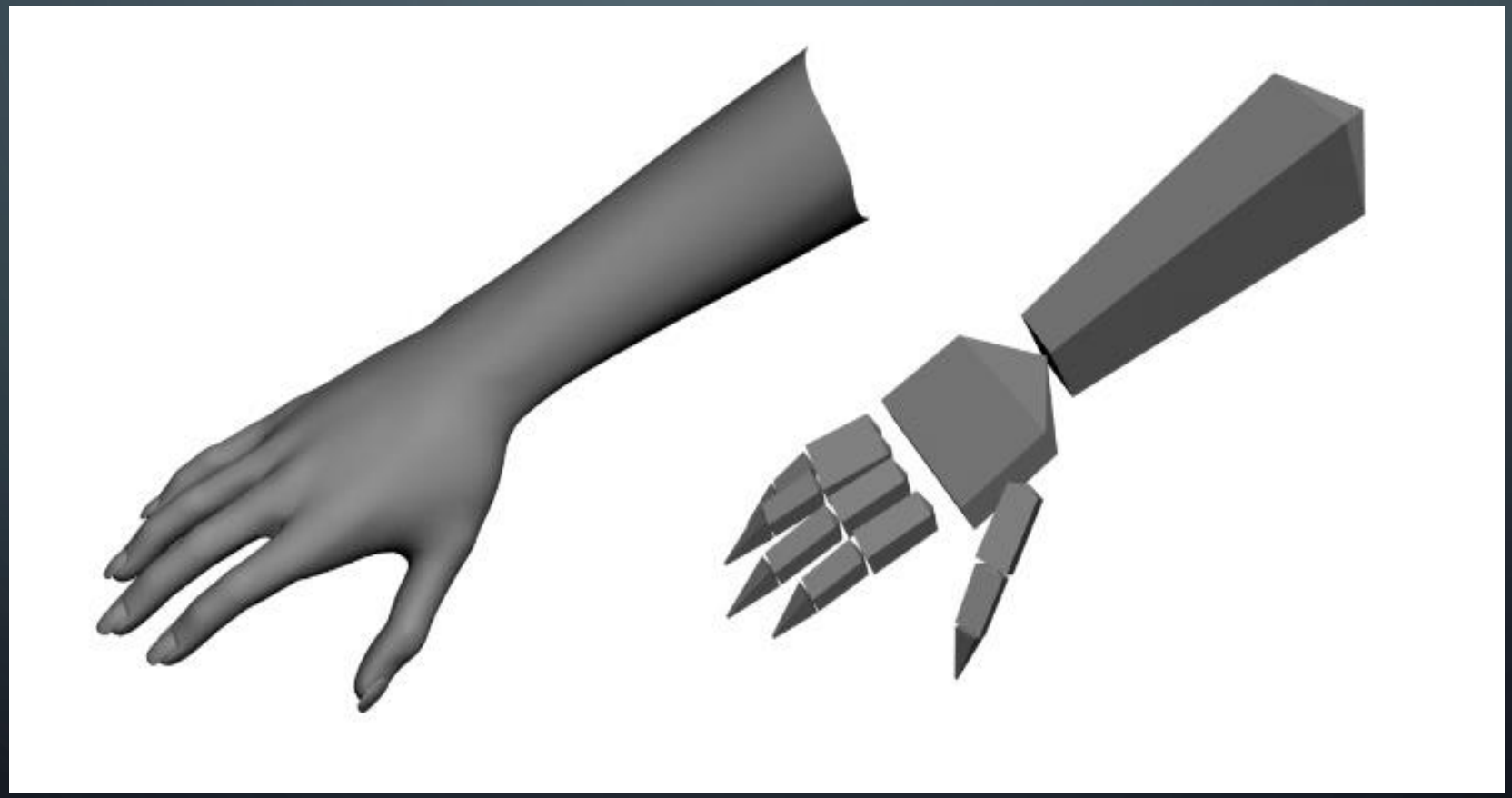
3D gesture handling - algorithm

- 3D model-based algorithms
- Skeletal-based algorithms
- Appearance-based models

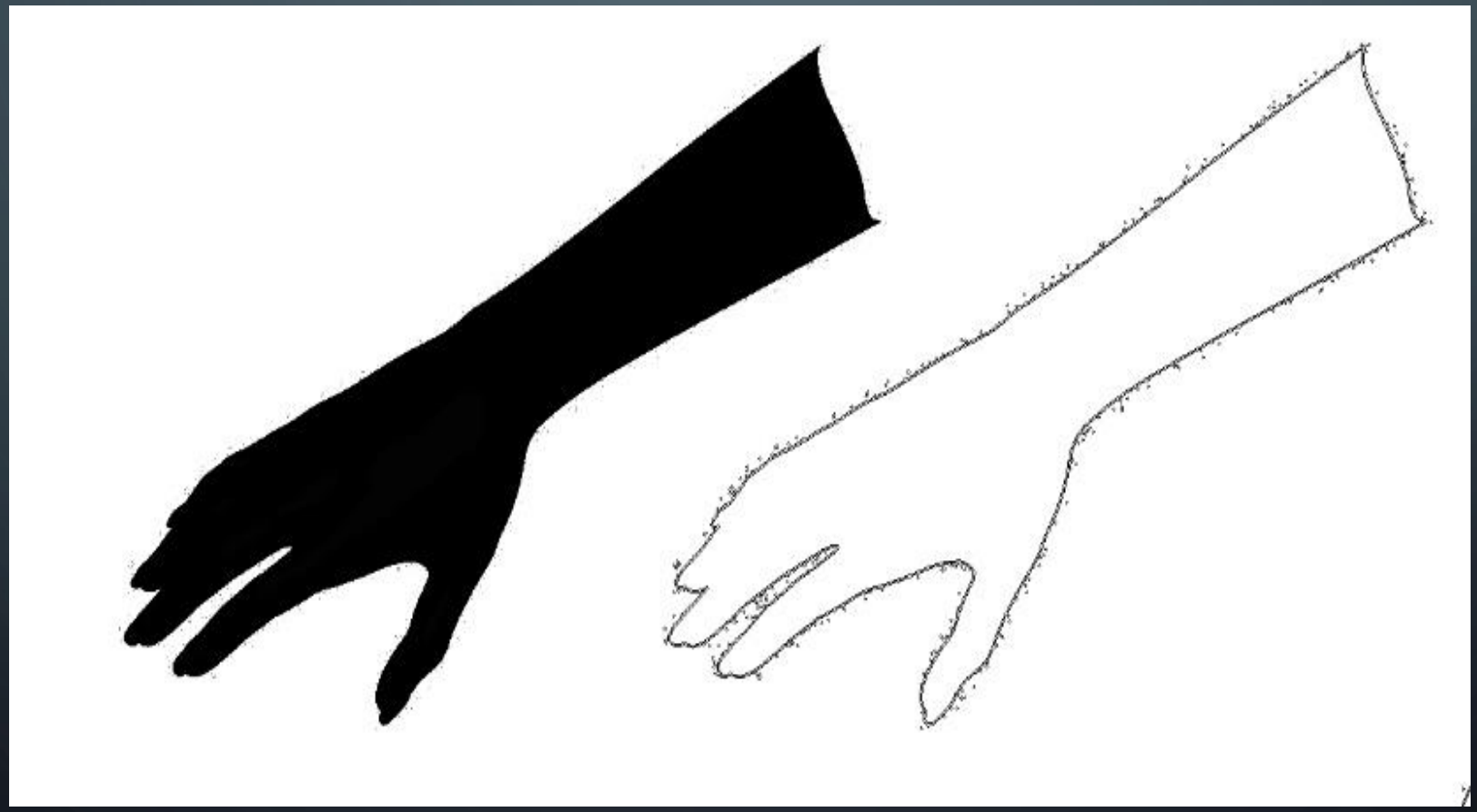
3D model-based algorithms



Skeletal-based algorithms



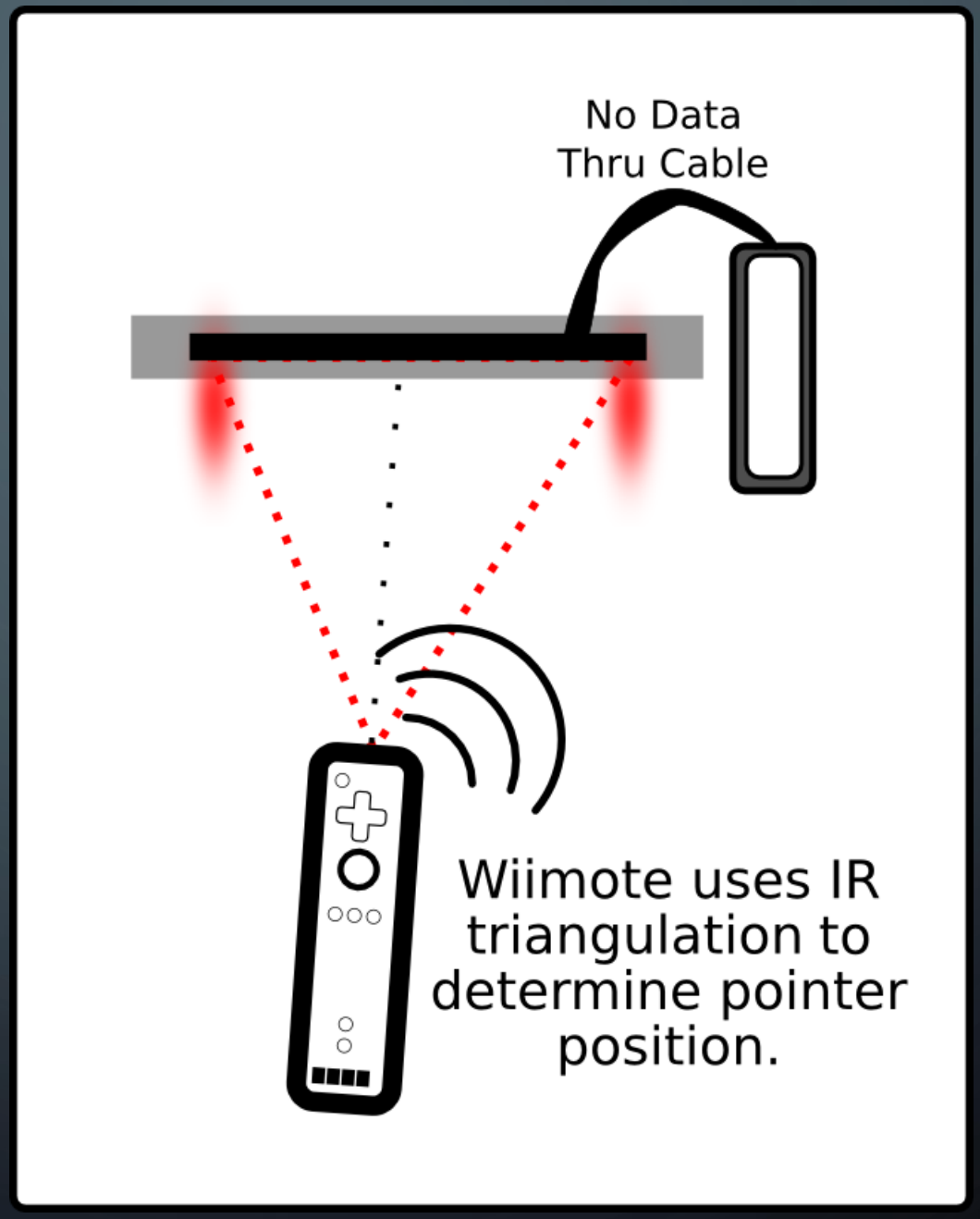
Appearance-based models



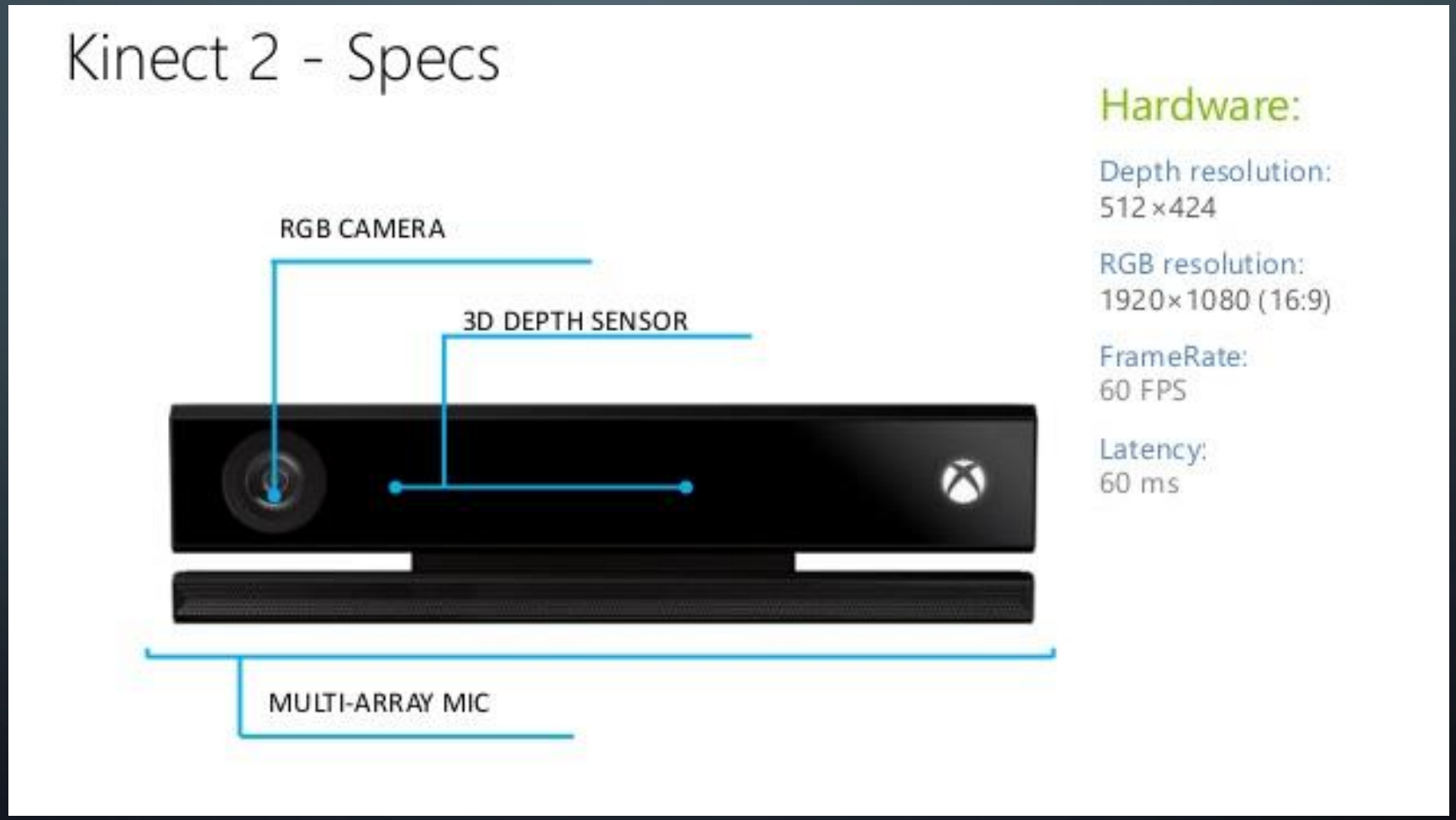
wired gloves

Gesture-based controllers

Wii Remote


No Data
Thru Cable
Wiimote uses IR triangulation to determine pointer position.

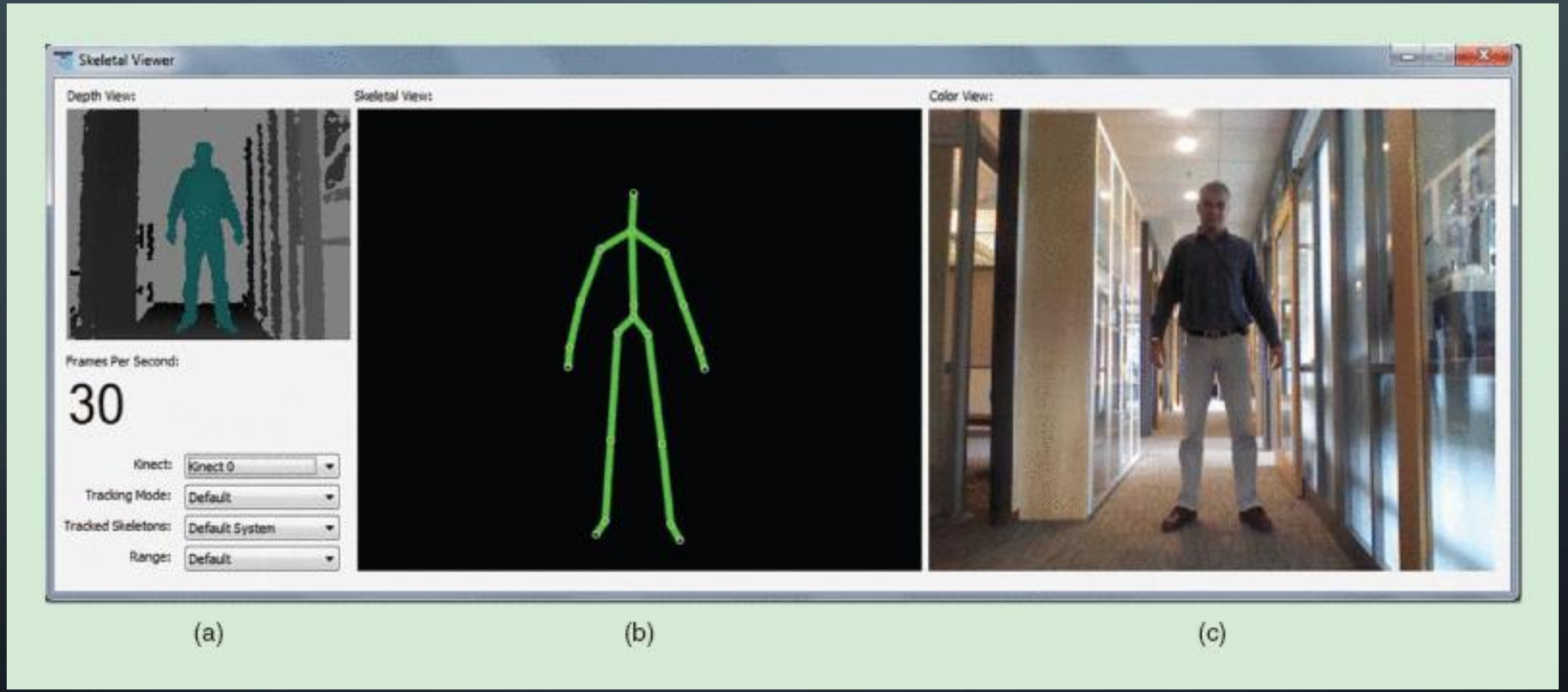
Depth-aware cameras



Kinect Software Development kit

- designed for Windows applications (but many on the web have developed IOS friend wrappers and libraries)
- could lead to innovative Kinect-ready software for industries like education, healthcare and transportation
- Kinect for Windows SDK commercial license for app release

Kinect Software Development kit



Conclusion

- Exciting new field with a lot of research and development
- Becoming more popular with increasing popularity of smart phones and VR/AR applications
- There are still some limitations to gesture-based UI
  - Noise
  - Difficulty of recognizing the right thing
  - Tiredness?