# A USABILITY USER STUDY CONCERNING FREE HAND MICROGESTURE AND WRIST WORN SENSORS

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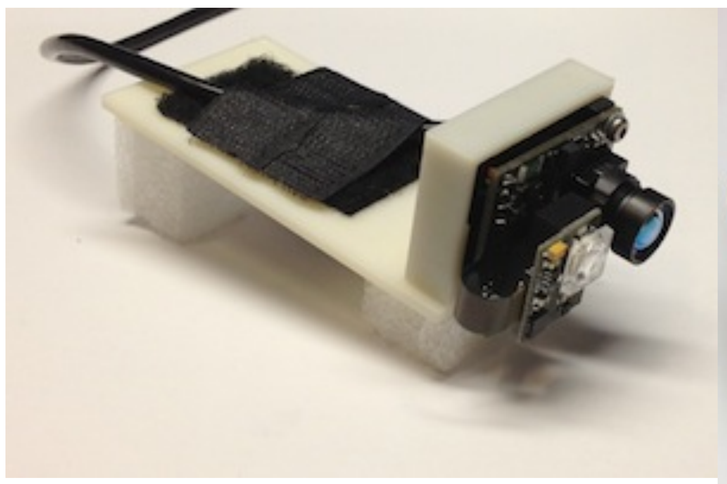
## MOTIVATION

- Wrist worn sensors have gained the attention of Human Computer Interaction (HCI) and body sensor researchers for their potential ability to aid interaction with wearable devices.
- Our goal was to determine which microgestures should be included in a potential universal microgesture language and identify any underlying microgestural usability principles.

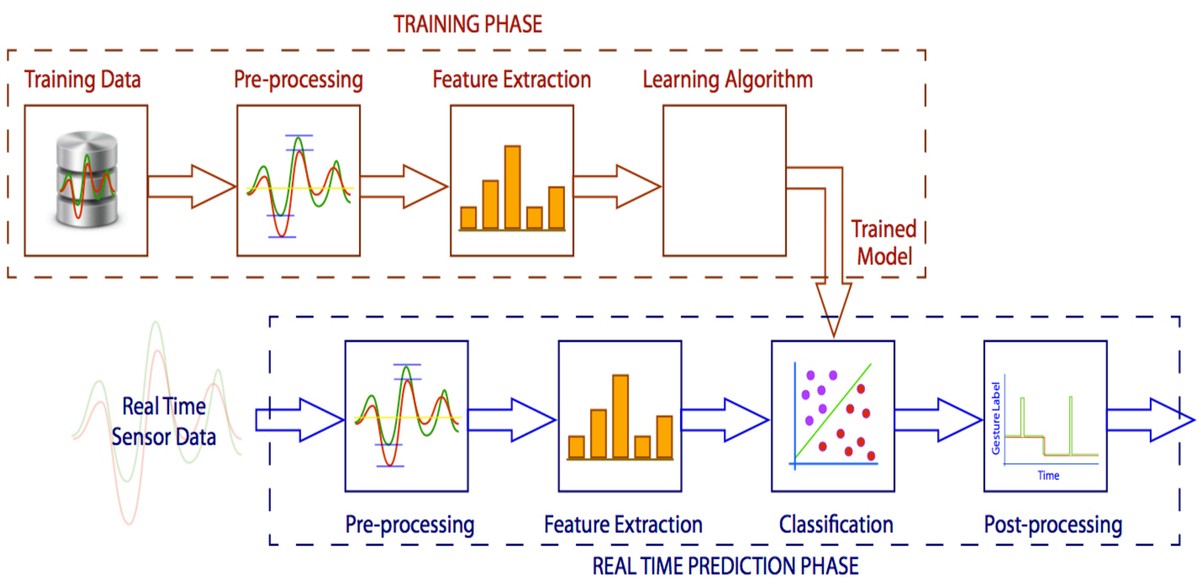
## SENSING MODALITIES



- To detect microgestures, we utilize a time-of-flight (TOF) camera PMD CamBoard Nano and a small MEMS microphone.
- While the size of the device is currently too large and power inefficient for everyday use, we believe that such devices are currently improving to warrant this research.
- This form factor draws up on many previous systems (including Microsoft Digits) but utilizes a novel form of feature extraction.

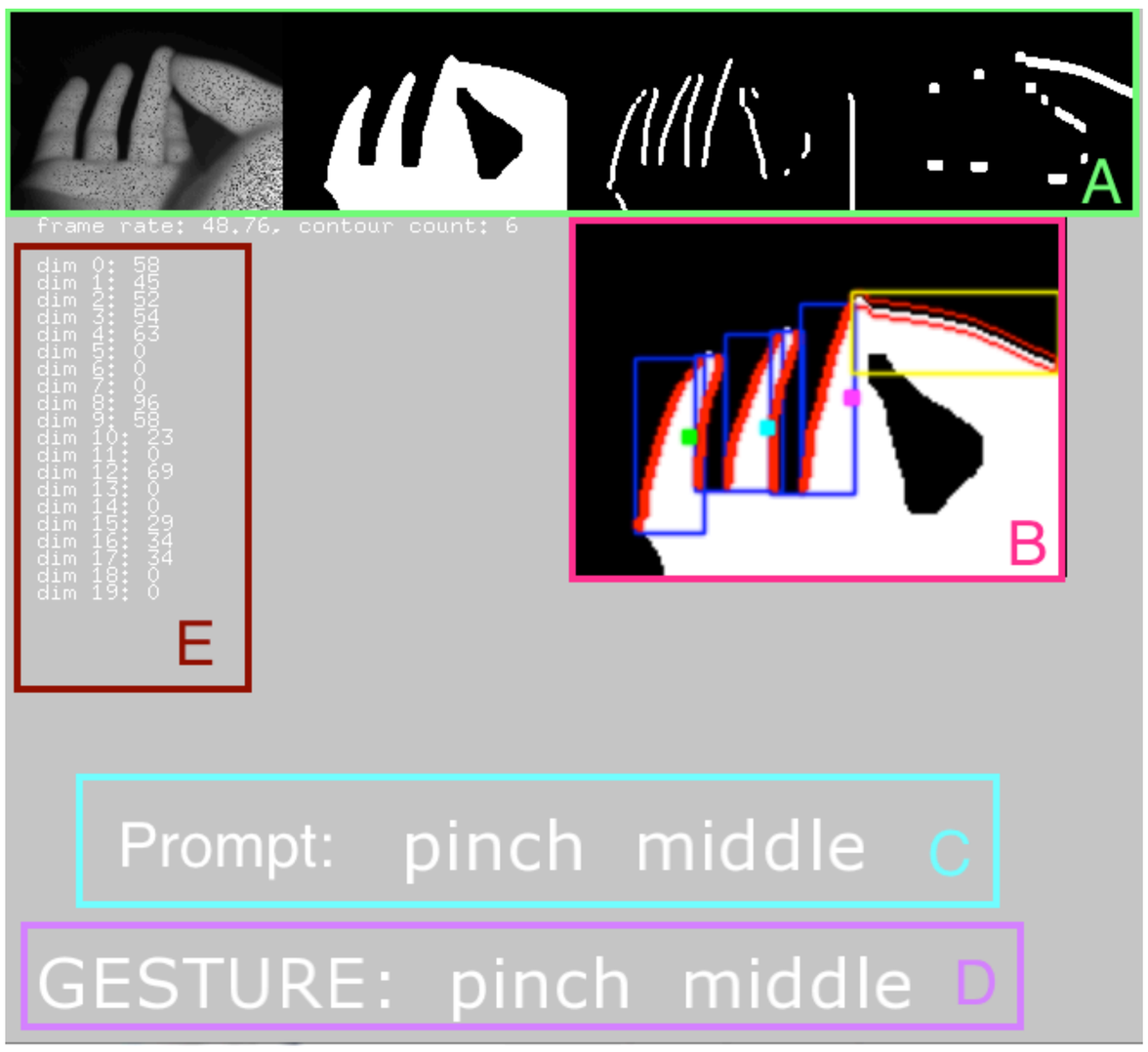
## FEATURE EXTRACTION

- To process data taken from the sensors, we utilize open source software OpenCV and Gesture Recognition Toolkit (GRT). We extracted training data from each user utilizing this pipeline:



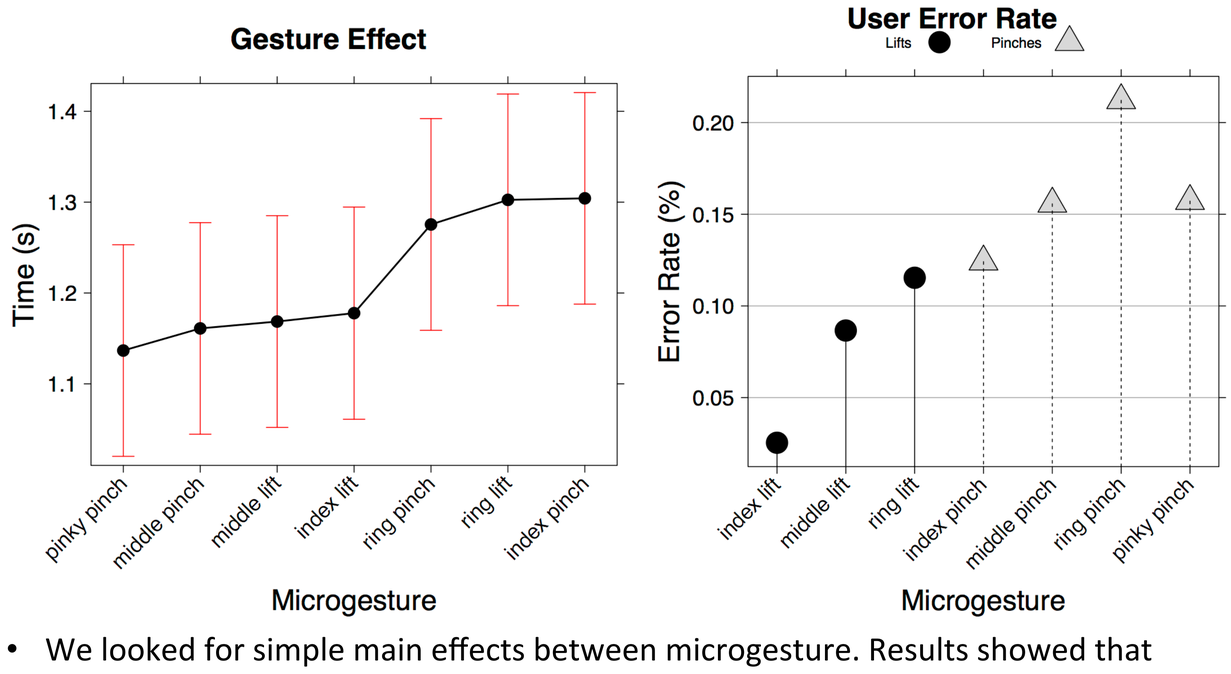

- Using OpenCV and the TOF camera, we extract finger-level features produced by various microgestures: finger length, finger spacing, relative thumb location, finger proximity, and alternate surface detection.
- Using these features, we formulate personalized bag-of-words sigmoid kernel support vector machine (SVM) models through GRT.
- Since the benefits of this methodology are unclear, we used EMGRIE to primarily study user interaction and usability principles behind potential microgesture interaction.

## EXPERIMENT



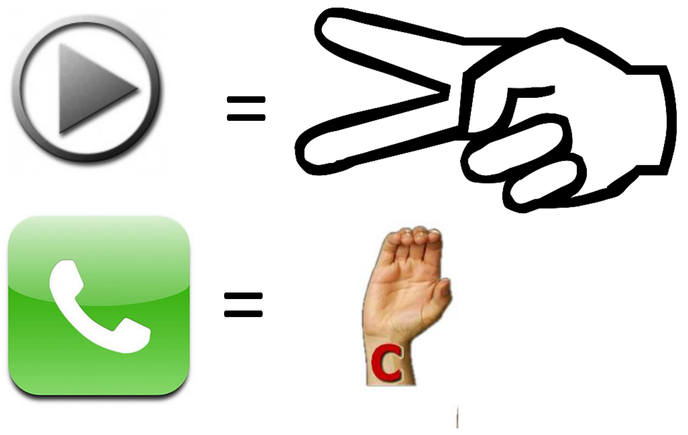

- The screen users viewed during experimentation. (A) Displays intermediate OpenCV Image processing and feature extraction steps (B) Finger tracking indicator display (C) The gesture for user to perform (D) Current gesture classification (E) Feature vector values.
- Time to recogntion and user error rate was recorded over 3 finger lifts and 4 pinches.

## RESULTS




- We looked for simple main effects between microgesture. Results showed that there were significant performance time differences between the index pinch and pinky pinch, and user error rate differences between the index lift and ring pinch.
- We believe that unnatural microgestures require more attention, and thus produce faster performance times and lower user error.

## FUTURE APPLICATIONS




- To continue this research, specific application design remains.
- Given design principles found in user error trends and performance times, we can better design applications such as selection, shortcuts, mobile games, text entry, and other interfaces .