

Annapurna: Building a Real-World Smartwatch based Automated Food Journal

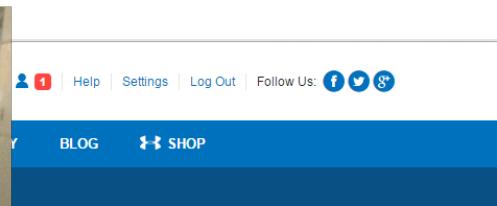
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NEED FOR AUTOMATED FOOD JOURNALING



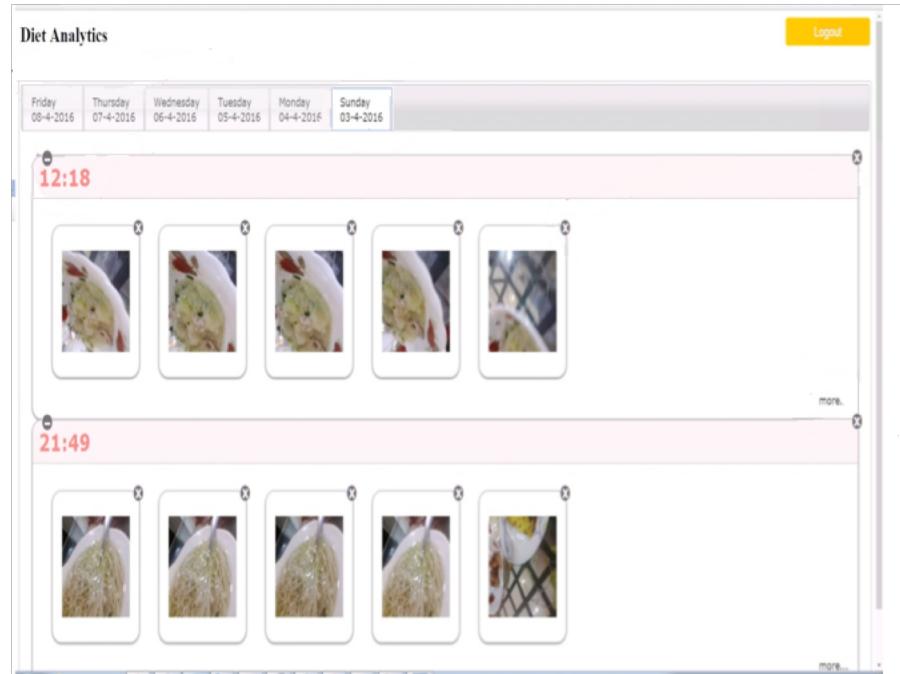
- Obesity
- Diseases
- Mood



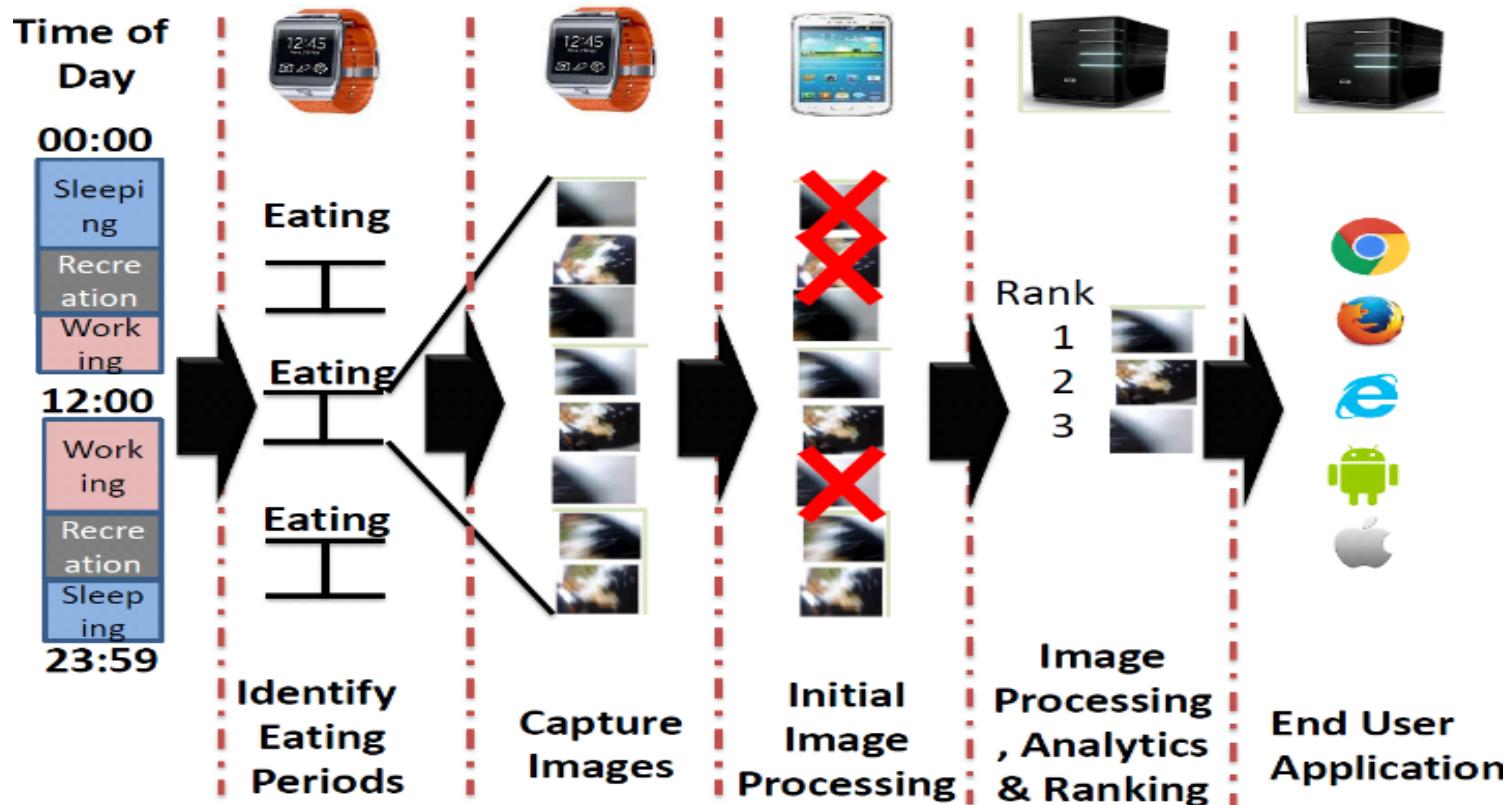
er + Gyroscope
era

ANNAPURNA: EATING ANALYTICS SYSTEM

- **Goals:**
 - Unobtrusively capture both the eating activities of a user AND the food that she consumes
 - Provide users with a personalized portal showing the food consumption patterns
- **End-use cases:**
 - **Diet monitoring:** self-awareness
 - **Real-time alerts:** unhealthy eating habits
 - **Eating forensics:** diagnose allergy causes in children



ANNAPURNA: PIPELINE



ANNAPURNA: FEASIBILITY STUDY DETAILS

21 Participants

- 13 male, 8 female
- 5 nationalities

Sensor Data Collected

- Accelerometer
- Gyroscope
- Continuous Image frames

135 episodes

Food Item	Completion Time (Seconds)			Hand to Mouth Gestures (count)		
	Min	Max	Avg	Min	Max	Avg
Rice (~100 gms)	211	1140	568	22	54	33.5
Sandwich	255	363	299	6	35	14.4
Pasta/ Noodles	234	711	459	12	35	27.3
Fruits (~15 pieces)	51	387	183	7	23	13.5

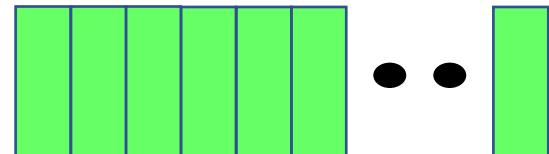
ANNAPURNA: GESTURE RECOGNITION

135 Episodes

Hand-to-Mouth
Gesture

Data

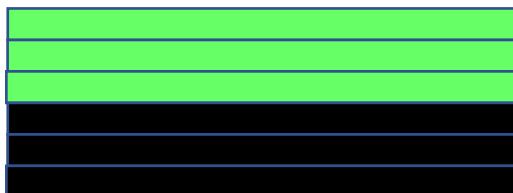
Hand-to-Mouth Gesture



Details of the gesture recognizer can be found in “Sen, S., Subbaraju, V., Misra, A., Balan, R. K., & Lee, Y. Experiences in Building a Real-World Eating Recogniser. In 4th International Workshop on Physical Analytics (WPA 2017, collocated with Mobicom), 2017.”

Other *similar to eating* gestures

Feature Extraction



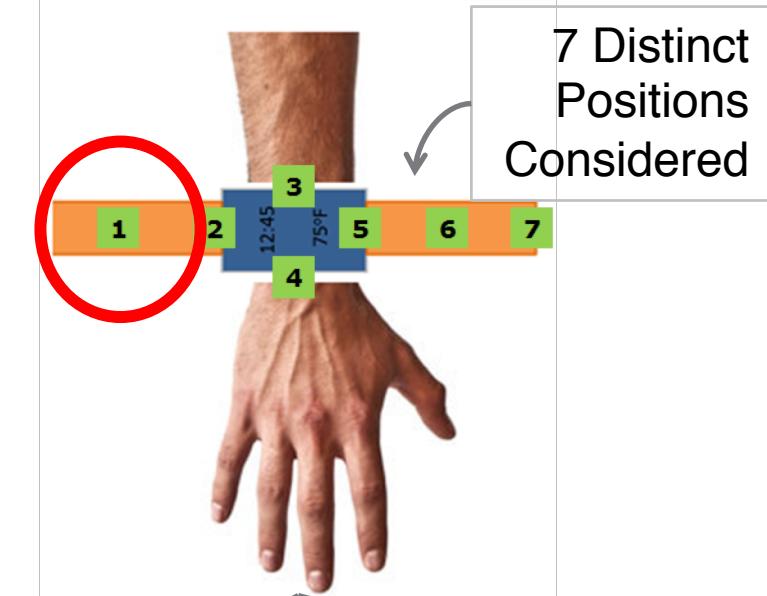
Feature Extraction

Model
Building

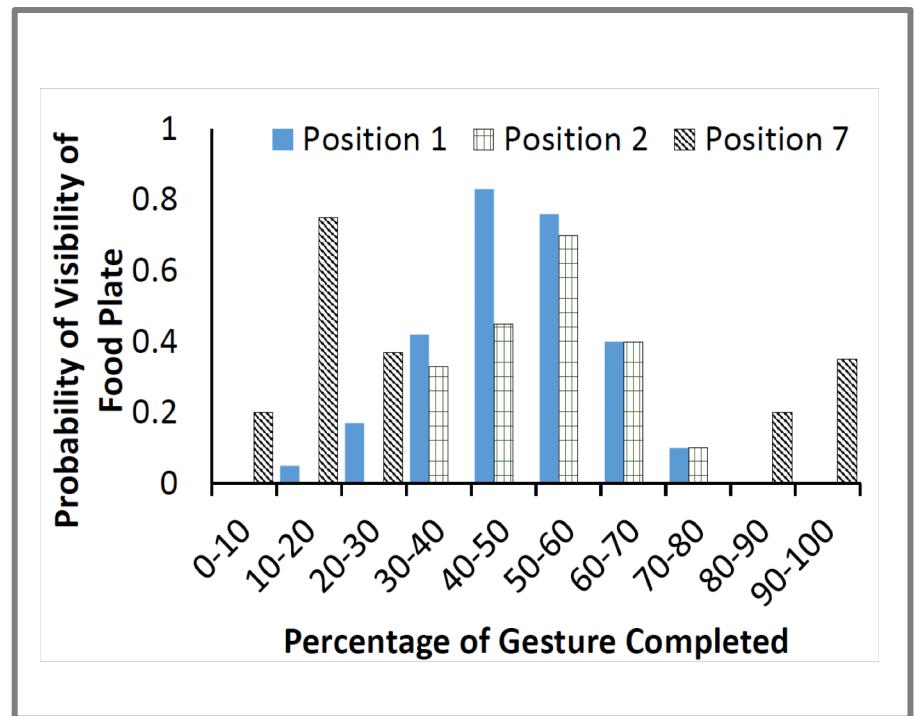
Model Used in the
real-world studies

POSSIBILITY OF CAPTURING IMAGES

Feasibility vs. Camera Position



2 male participants
15 rice eating episodes

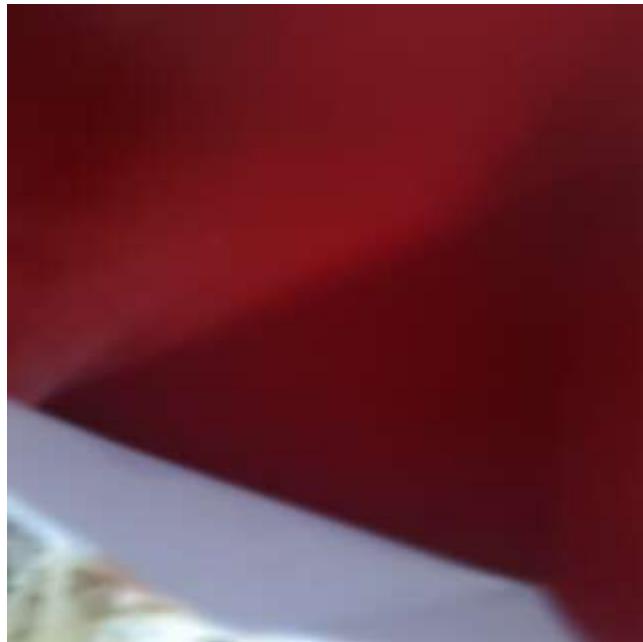


Samsung Gear 1
Positions 1,6,7

Samsung Gear 2
Positions 2, 5

Omate TrueSmart
Positions 3,4

EXAMPLES OF IMAGES CAPTURED: 1 GESTURE



THE IMAGE PROCESSING PIPELINE

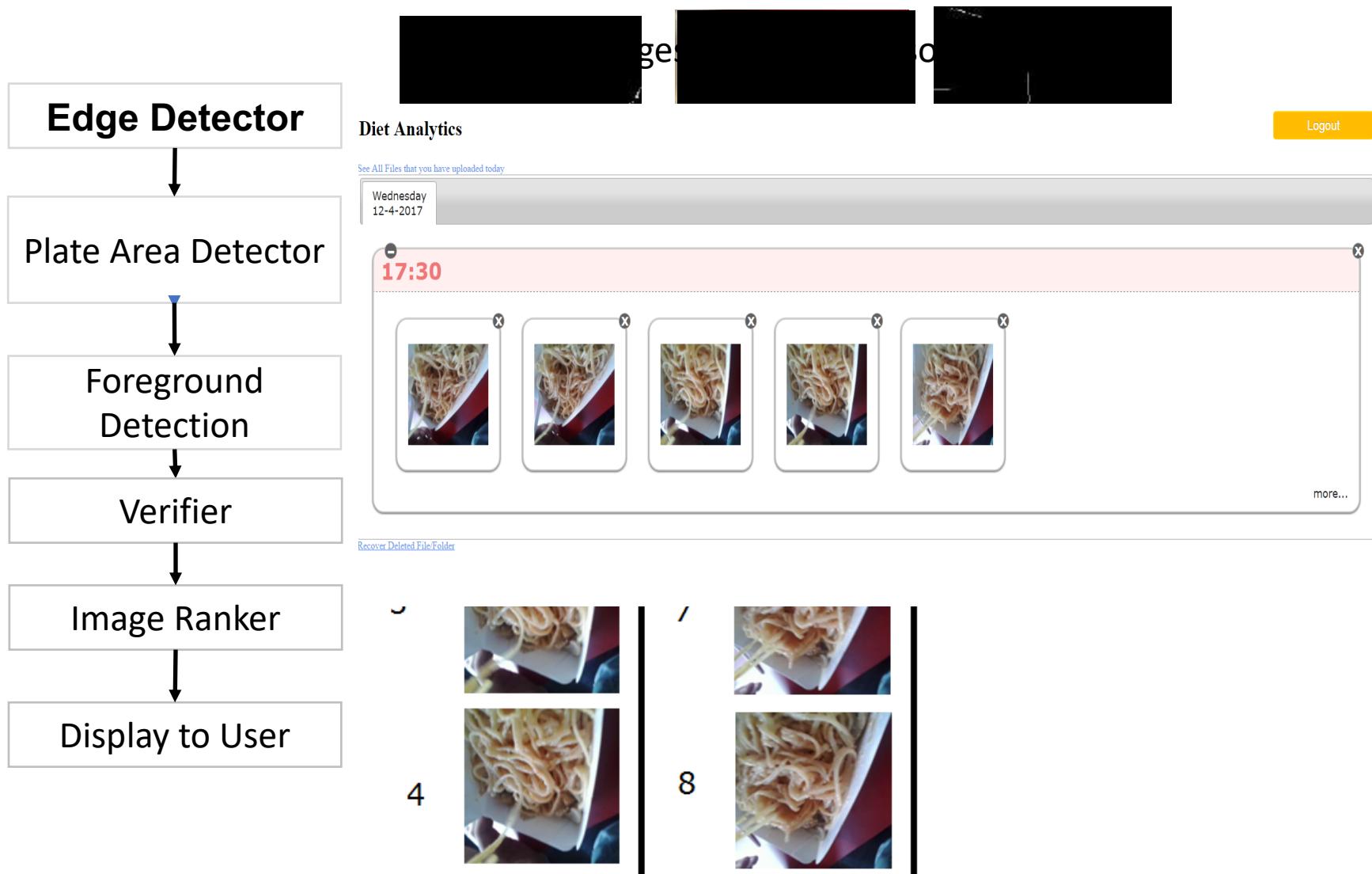
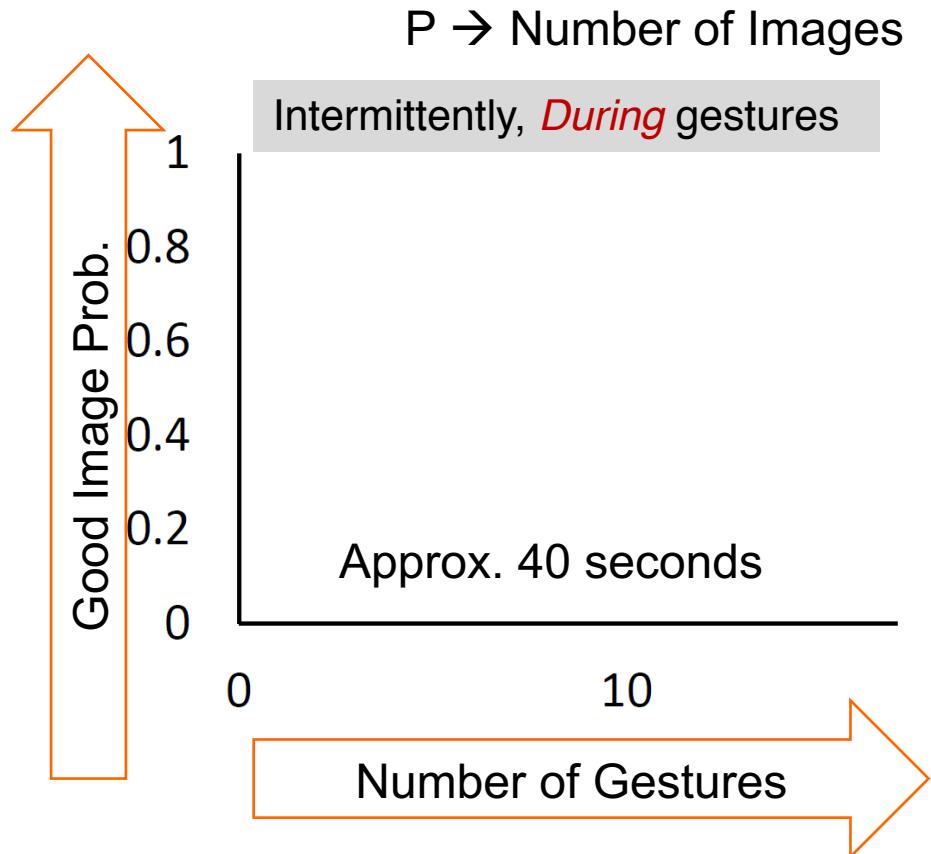
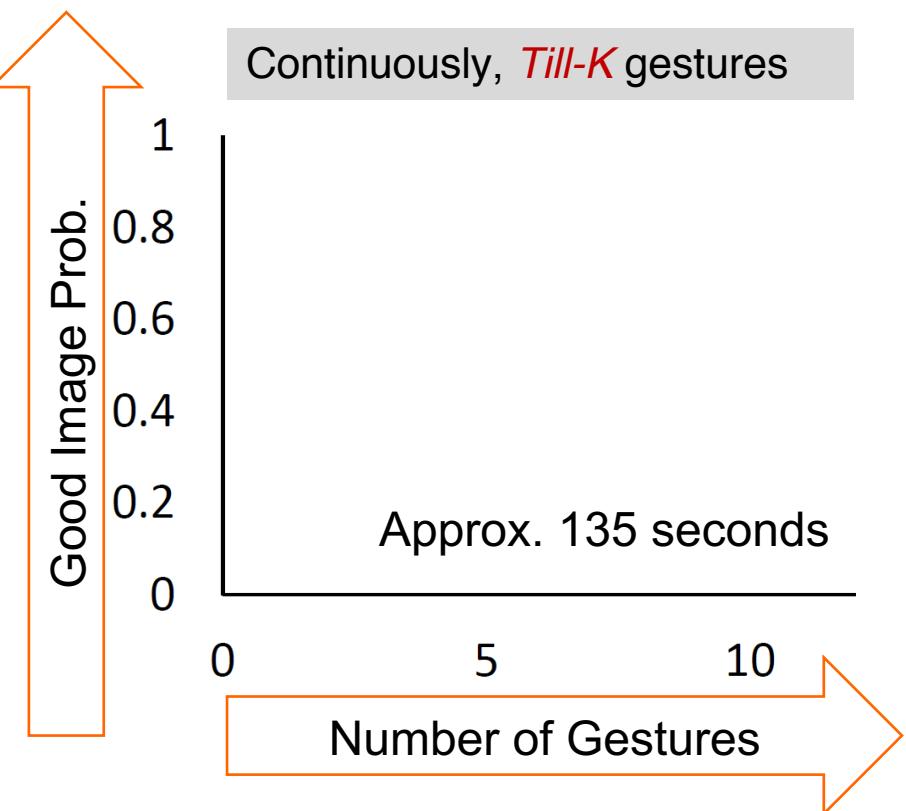


IMAGE CAPTURE CONSIDERATIONS

How Long to Capture?

$$\text{Good Image Probability}_k = \frac{\sum \text{good image for } k}{\text{Total Episodes}}$$



FINAL WEB APPLICATION

Screenshot of a web application titled "Diet Analytics". The interface includes a navigation bar with a "Logout" button, a section for viewing uploaded files, and a timeline of meals.

Diet Analytics

Logout

See All Files that you have uploaded today

Thursday
13-4-2017 Wednesday
12-4-2017 Tuesday
11-4-2017 Monday
10-4-2017 Thursday
06-4-2017 Tuesday
04-4-2017

12:20

more...

The screenshot shows a web-based diet tracking application. At the top, there's a header with a "Logout" button. Below the header, a section titled "See All Files that you have uploaded today" displays a timeline of meals from April 13, 2017, to April 10, 2017. Each meal entry consists of a thumbnail image of the food in a container, with an "X" icon in the top right corner of each thumbnail. A red digital clock in the center displays "12:20". Below the thumbnails, there is a link labeled "more...".

STUDIES IN DAILY LIFE SETTINGS

Study Details

Total number of Studies: 4

Studies with stable gesture recognizer: 2

Total Participants : 9

Number of days of data: 46

System Performance

Number of Meals Reported (Ground Truth): 81

Number of meals Identified (TP) : 77

Precision : 95%

Wrongly Identified meals by Gesture recognizer (FP initial): 45

False Positives corrected by the Image Recognizer: 41

Recall : 95%

WORD CLOUD WITH STUDY DETAILS

Word-cloud: in-the-wild eating

Salad Vegetable
Porridge Noodles Bread
Potato Pizza Pork Soup
FriedRice Idli PadThai
Egg Mango RiceCake

Chicken Upma
Noodle Beef Broccoli

Pasta Chapathi
Paratha Subway
Naan

Rice
Sandwich

Spoon Hand
Fork

Spoon+Fork
Chopstick+Spoon

Home
FoodCourt
Restaurant
CoffeeShop
Outdoors

SUMMARY

- We presented the Annapurna system for automated food journaling.
- We showed the possibility of capturing images of food using an embedded smartwatch camera
- We presented the image filtering approach to remove false images
- We showed that Annapurna is robust in identifying images of food in daily life setting – it can achieve a precision and recall of 95%.