

# Innovative tools for dietary assessment

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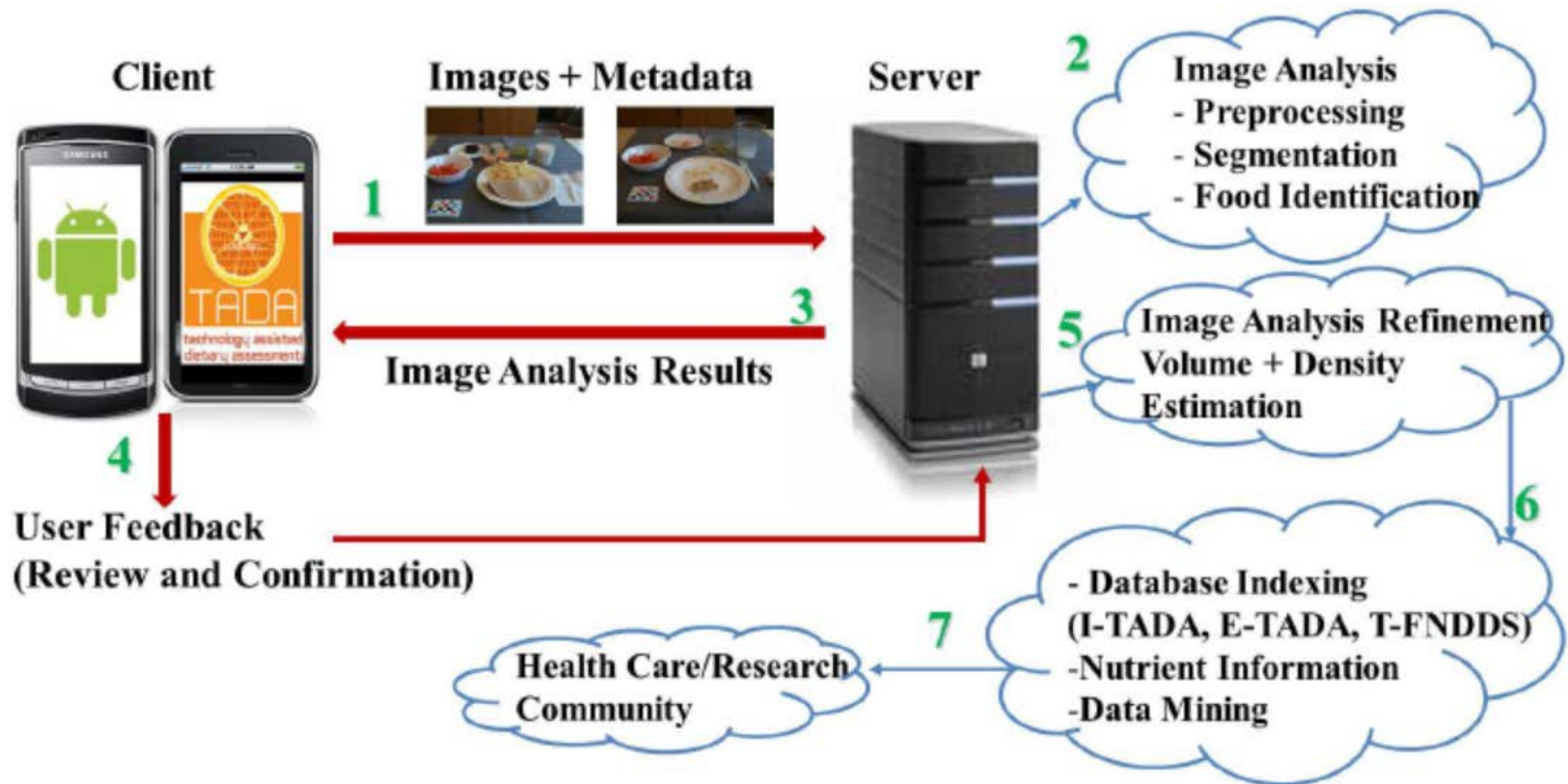
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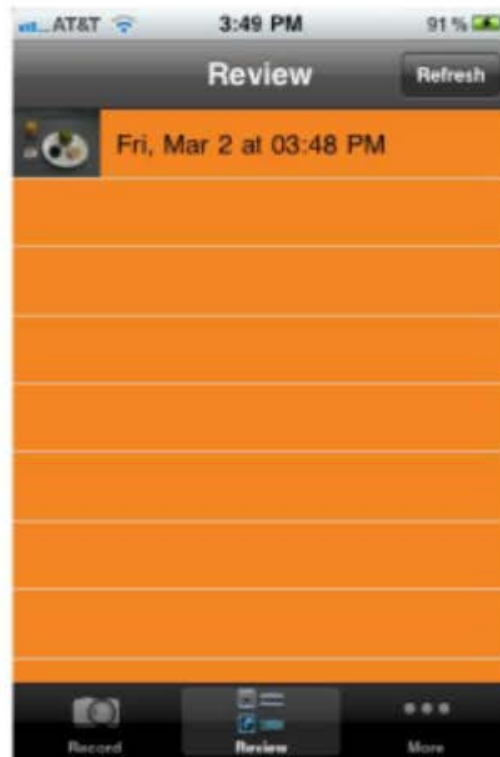
# Image-Based Dietary Assessment

- Convenient & reduces burden
  - study participants
  - researchers
- Richer source of information
  - a repository of images
  - images for future research and analysis
- A tool that will connect with study participants
- Improve accuracy

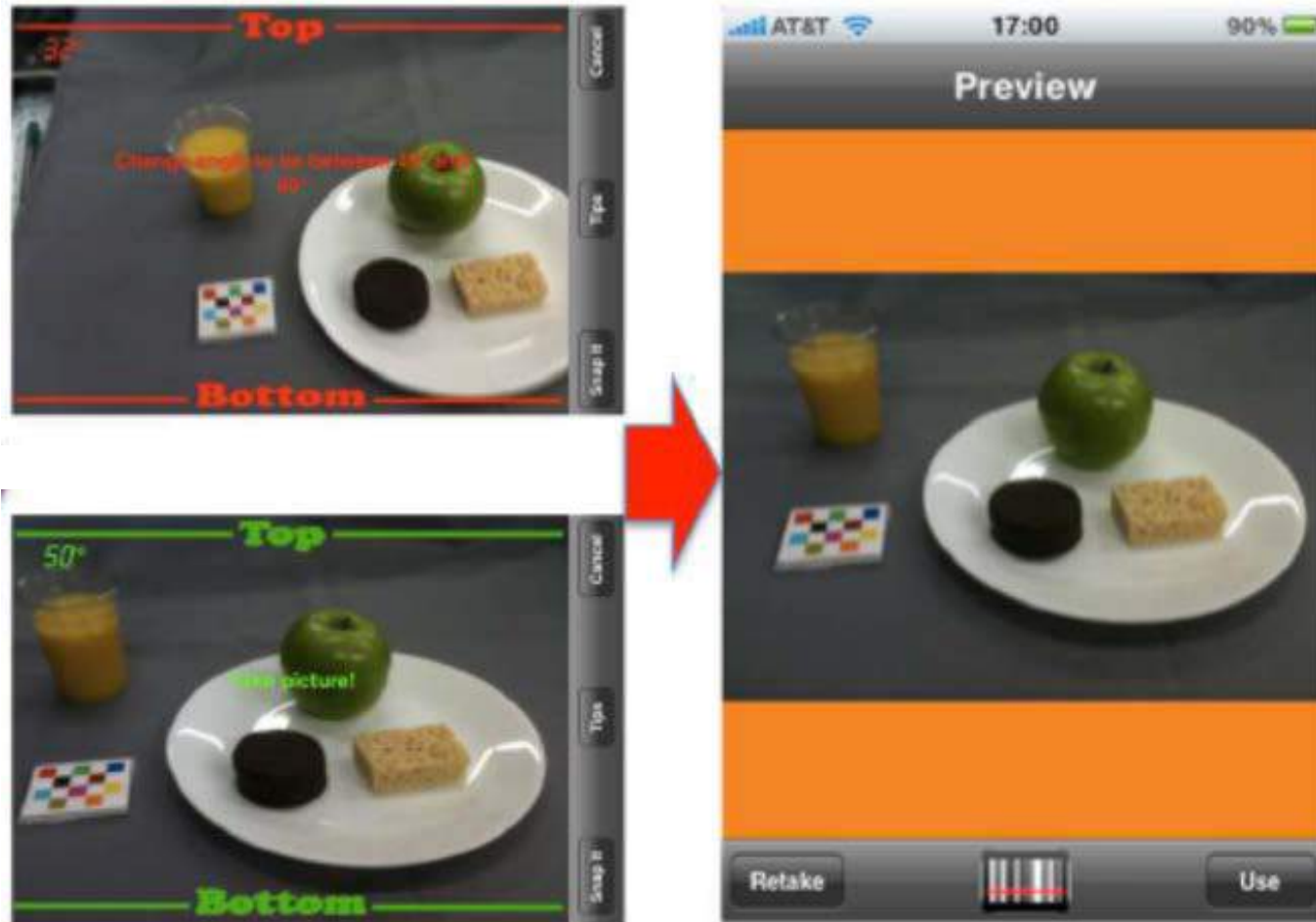
# Architecture of the Technology Assisted Dietary Assessment (TADA) image-based dietary assessment system



# Main views of the mobile food record (mFR) user interface

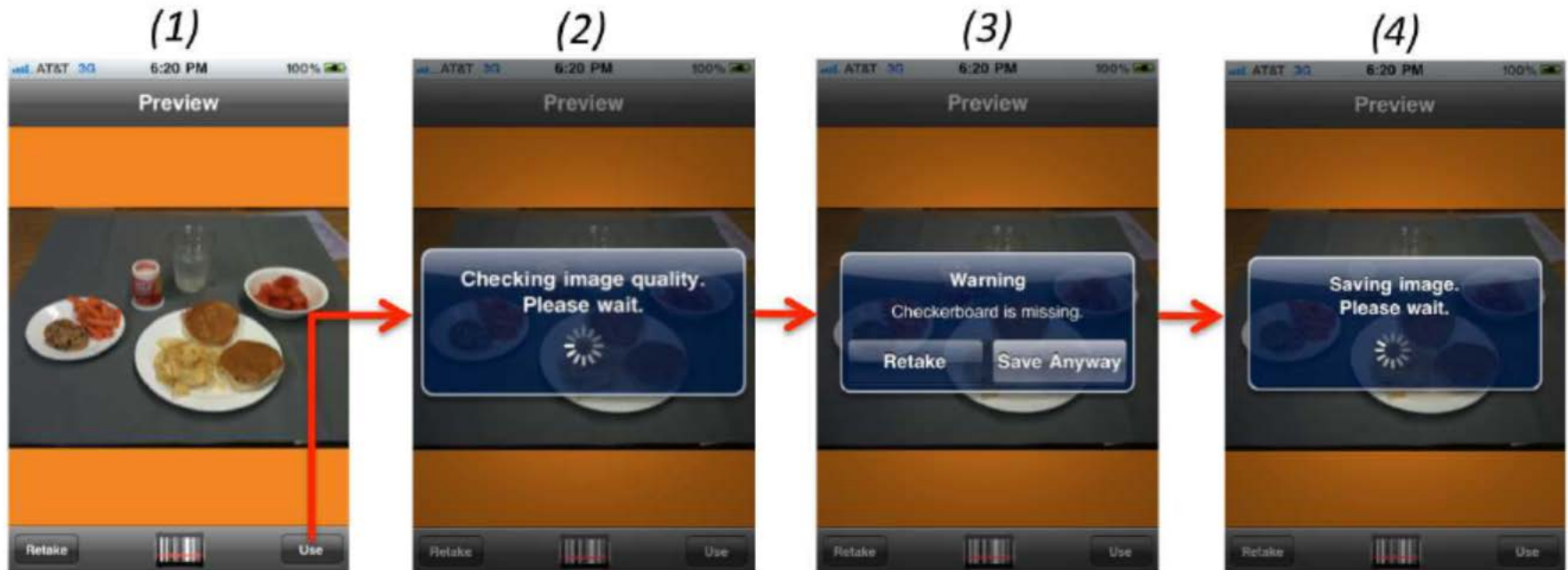


# Image acquisition process of the mFR application

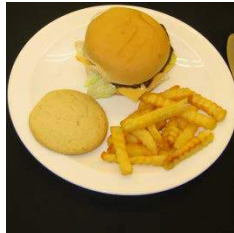




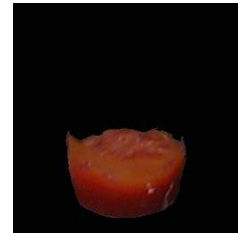
# Image quality checking in the mFR application



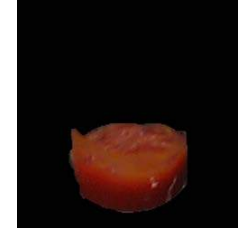
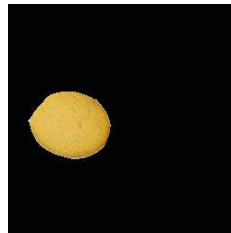
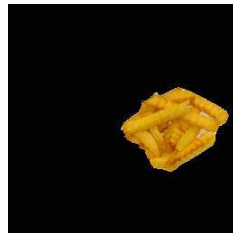
# Image captured by adolescent during a 24-hour feeding study



**Ground  
Truth**

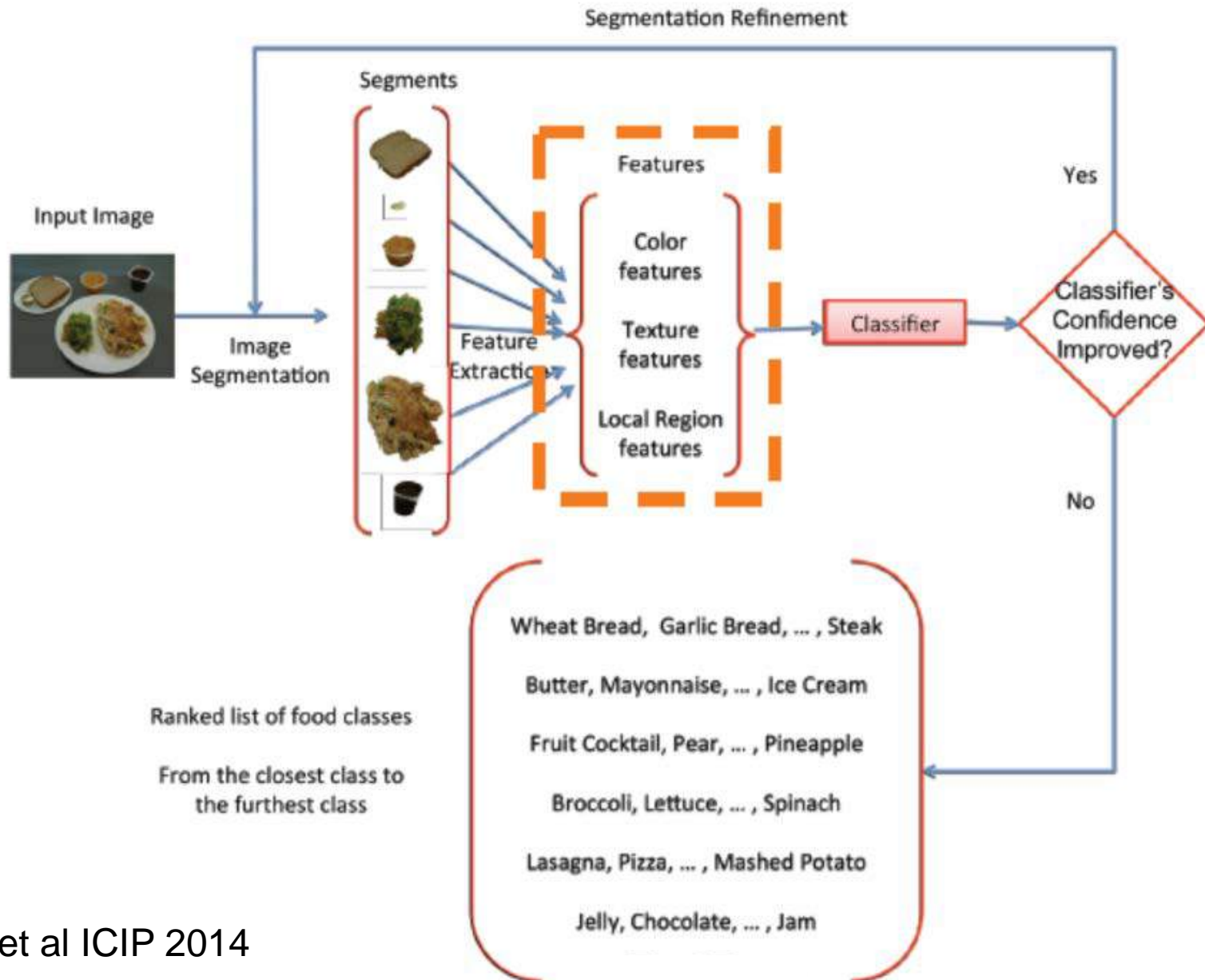


**Automatic**





# Feature Extraction



# Food identification

- Test images: 1453 images taken by 45 community dwelling participants over 7 days.
- Training images: 20-30 images per food class
- 42 food classes



# Feature classification results

Features	Classification Accuracy	
	Top 1	Top 4
DCD+MDSIFT	60.9%	83.3%
DCD+MDSIFT+SCD	62.9%	85.1%
DCD+MDSIFT+SCD +SIFT	64.5%	84.2%
DCD+MDSIFT+SCD +SIFT+EFD	63.5%	83.4%
DCD+MDSIFT+SCD +SIFT+EFD+GFD	62.9%	82.8%
Contextual Dietary Information	71.4%	88.3%

# Volume Estimation

## Comparison of Known Food Weights with Image-Based Portion-Size Automated Estimation and Adolescents' Self-Reported Portion Size

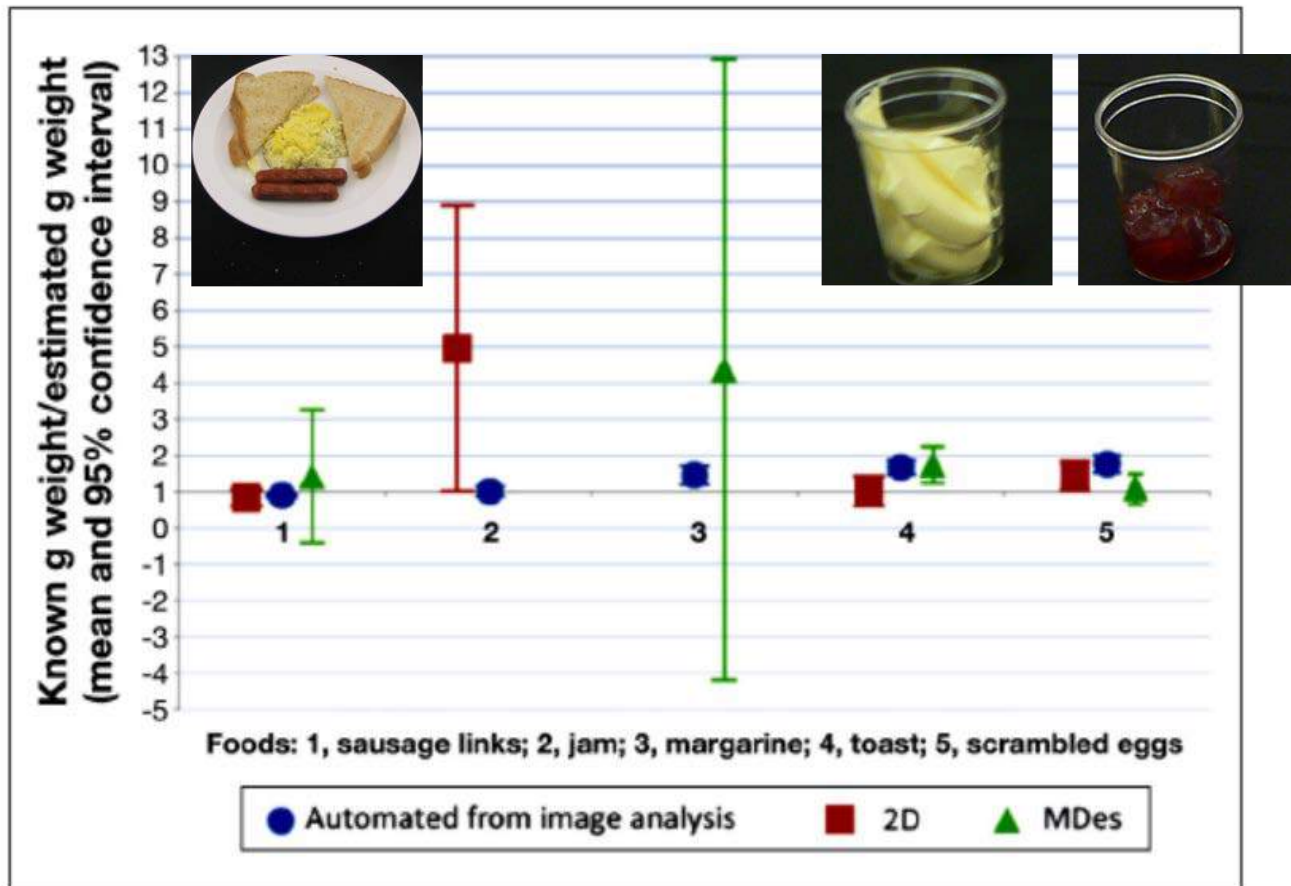


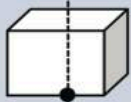


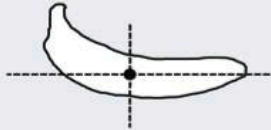


Figure 2. Weight error from images taken by 15 adolescents (11–18 years) at a breakfast meal. Ratio greater  $>1$  is overestimated and ratio  $<1$  is underestimated (mean and 95% CI). 2D, two dimensional portion estimation aid; MDes, multiple descriptors, e.g., cup, teaspoon. See text for further description.



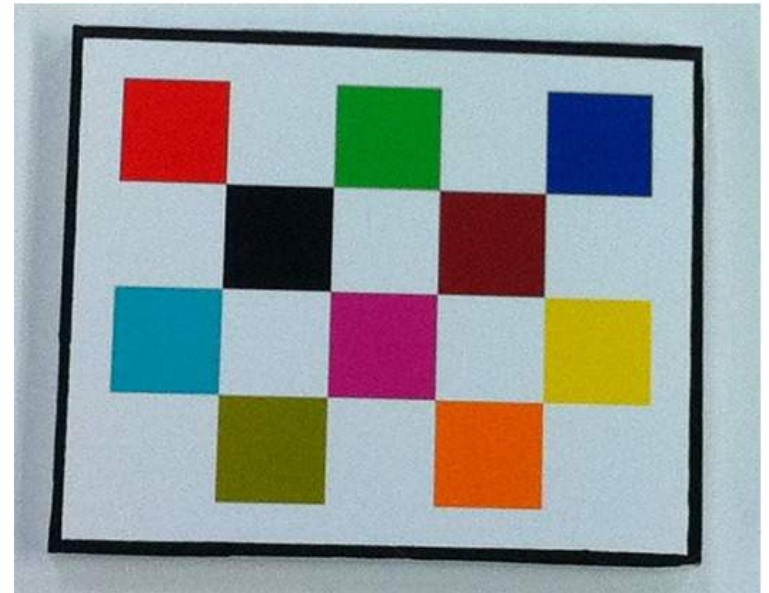
# Generate or Pre-Define Food Shapes

Shape	Example Food Type	Dimension Parameters	Locator
Cylinder	Orange juice, Milk	Radius, Height	
Sphere	Apple, Orange	Radius	
Square Box	Chococolate Cake, Brownie	Width, Length, Height, Rotation Angle	
Slice of Cone/ Slice of Sphere	Spaghetti, Ice Cream	Top Radius, Bottom Radius, Height	
Prism	Bread, Scrambled Eggs	Area, Height	
Irregular Shape	Banana, Pear	Scale X, Scale Y, Scale Z, (Rotation Angle)	



# TADA Fiducial Marker

- TADA color fiducial marker plays an important role for dealing with the challenges involved in food classification and volume estimation from a single image
  - Geometric reference
  - Color reference
  - Image quality reference
- Real time image quality check on the mobile phone



# Examples of studies using TADA system

- TADA Café

- Controlled conditions
- Men & women, 21-65 y
- 1 to 2 meals
- n = 57

- Food in Focus

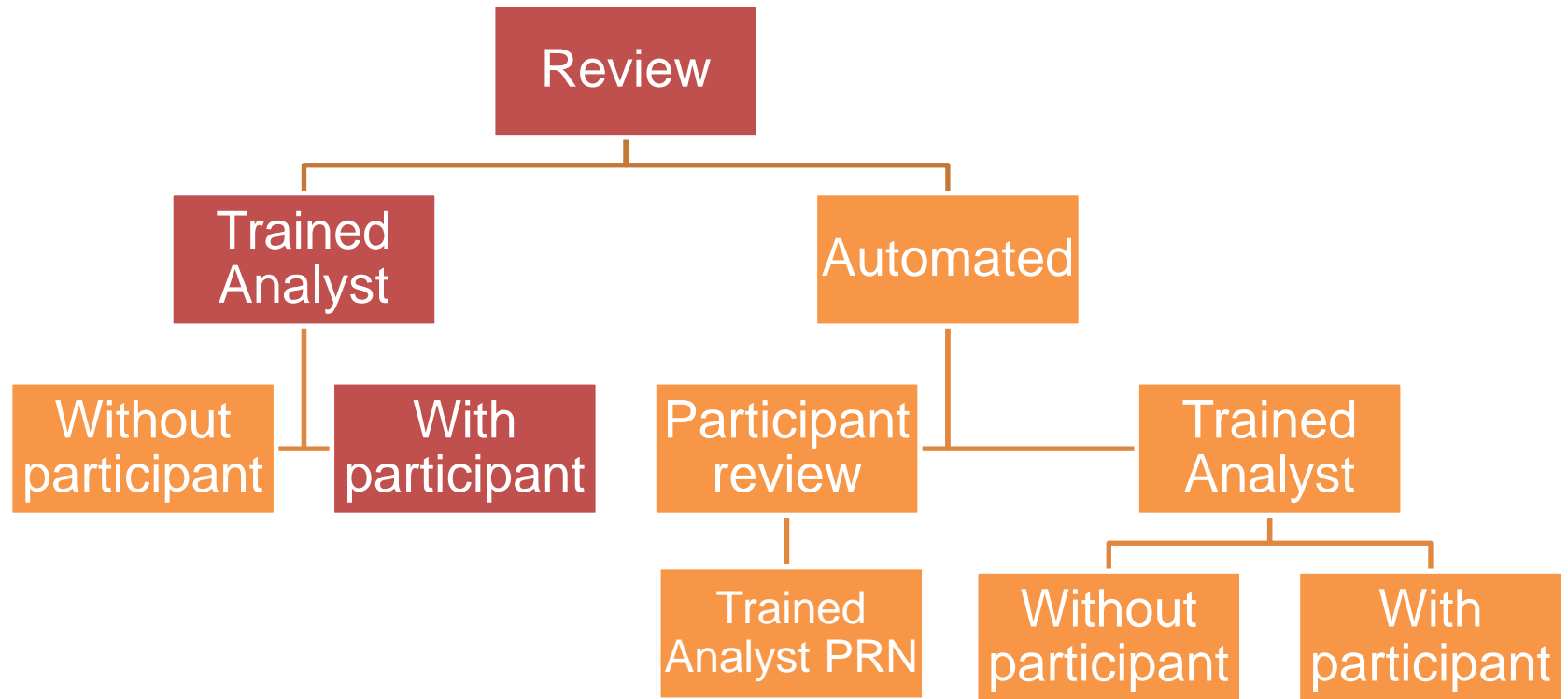
- Community dwelling
- Men & women, 21-63 y
- 7 days
- n = 45

- Connecting Health and Technology (CHAT)

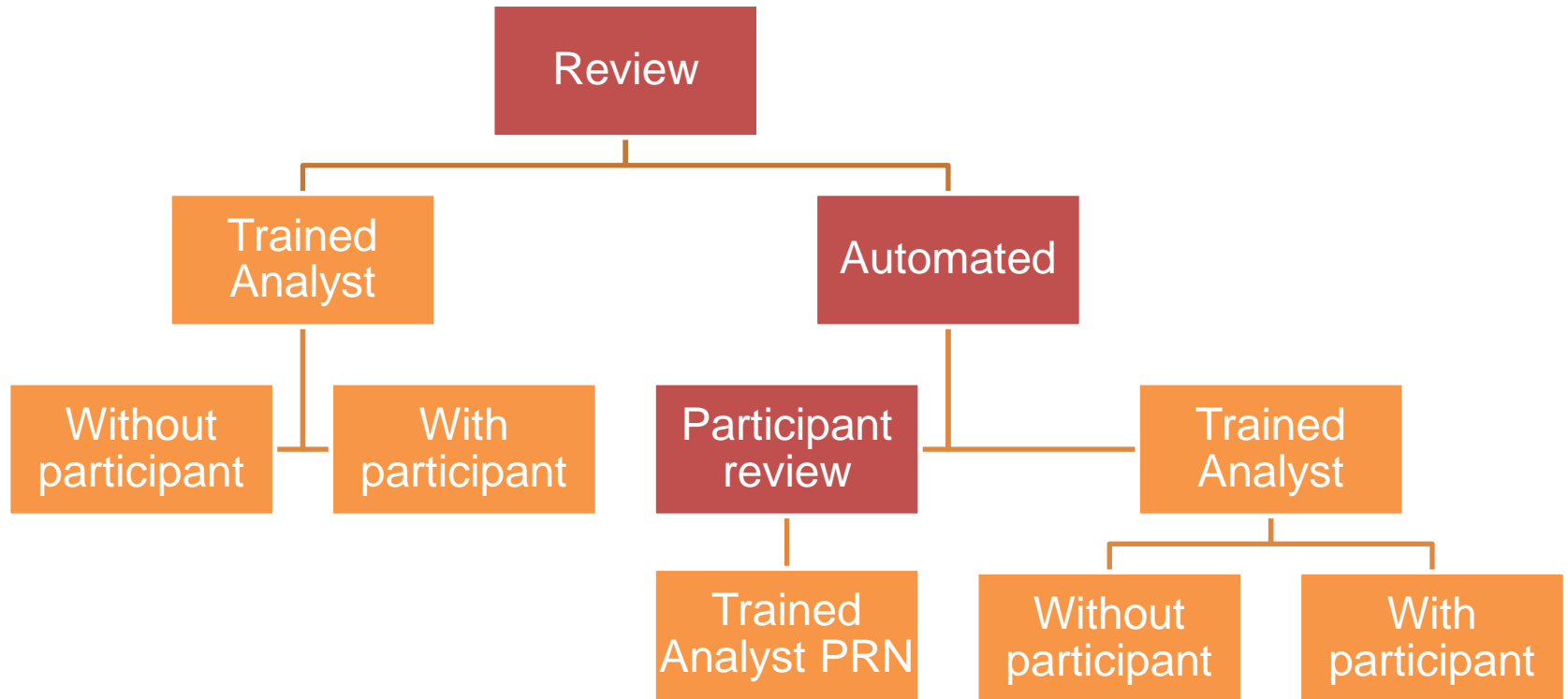
- Community dwelling
- Men & women, 18-30 y
- 4 days
- n = 241



# Review Process



# Review Process



Community Dwelling								
Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
Thu	Fri	Sat	Sun	Mon	Tues	Wed	Thu	Fri
n = 46	Men = 15 (33%) Women = 30 (67%) Mean age = 32 y (range: 21-63 y)							n = 45
User training & mobile telephone distribution								Return mobile telephone



# Conclusions

- Image-based dietary assessment appears to be a promising dietary assessment method
- Improvements in technology are likely easier to pursue than changes to humans
- Images will broaden research questions due to better information about the microenvironment and temporal aspects of eating.