

Sophisticated Image Recognition in Hardware

A kitchen sink area with a person in the background. The sink is stainless steel and contains several metal dishes, including a large bowl and a pot. A coiled metal faucet is positioned over the sink. To the right of the sink is a wooden door with a poster on it. A person wearing a black t-shirt with the text "MIT POWERBOTS FEBRUARY 2, 2015" is walking away from the camera towards a doorway on the right. The t-shirt text is in white and green. The person is also wearing red pants. The background shows a white wall and a doorway leading to another room.

Curse you Juan Leaver of Dishes!!!

Motivation- Look ma, no processor

Sophisticated image recognition at low power consumption

Real time detection

Reusable hardware for recognition of new objects

Hardware implementation of ML algos/Feature extraction typically done in SW

Machine Learning Approach

How can a computer recognize a face?

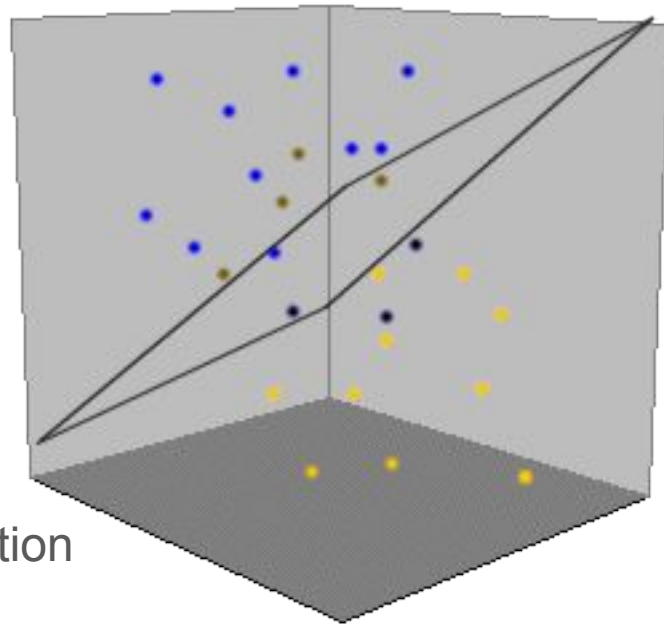
Texture \rightarrow LBP

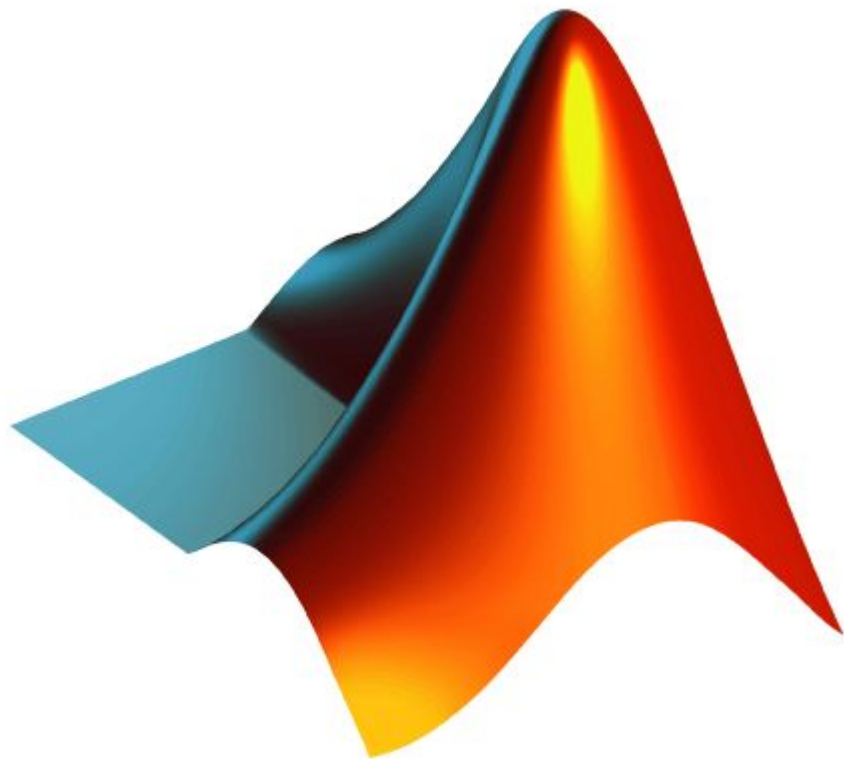
How do we get a better classification

Features, histograms, classification

Tallying the votes (AdaBoost) \rightarrow Activation function

How does AdaBoost decide?





Algorithm Selection

Divides are expensive

Compares are cheap

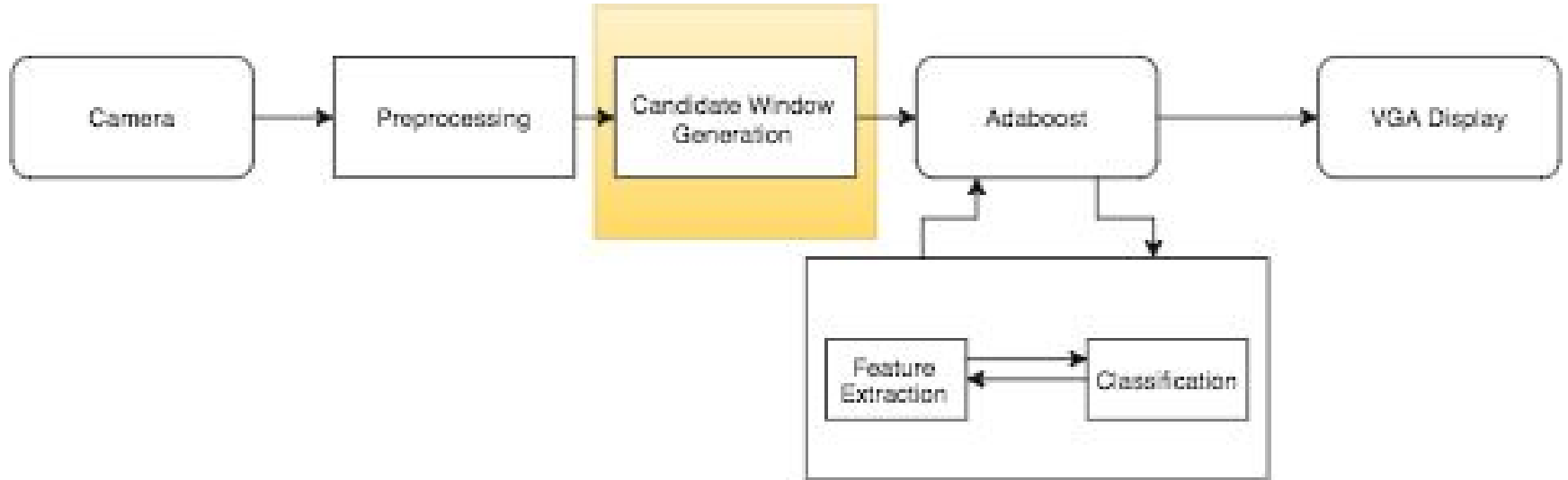
Feature Rep - 8 comparisons per pixel (LBP)

Feature Extraction- 80 adds per feature (LBP Histograms)

Classification- 256 divides, 255 adds per Feature Vector,(dot product with weight vector)

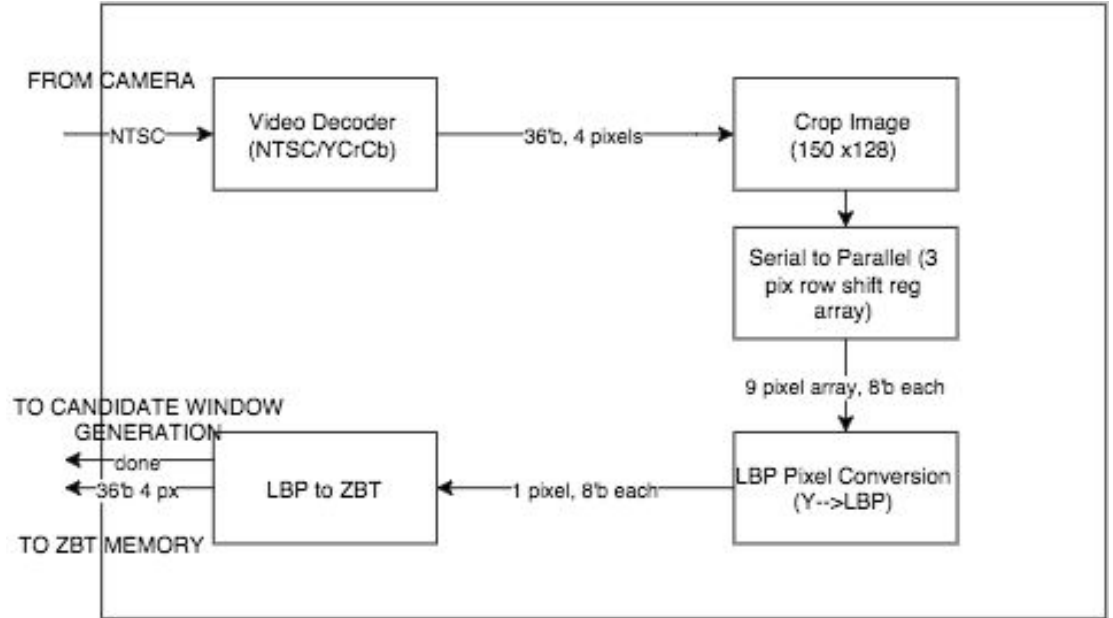
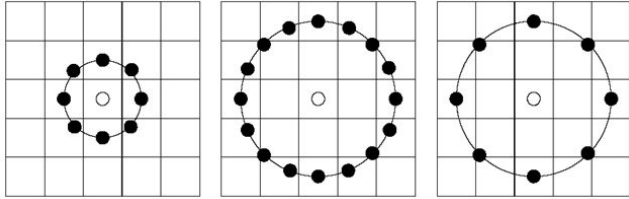
Refinement- 240 divides, 239 adds per Classification Vector,(dot product with weight vector)

Overview



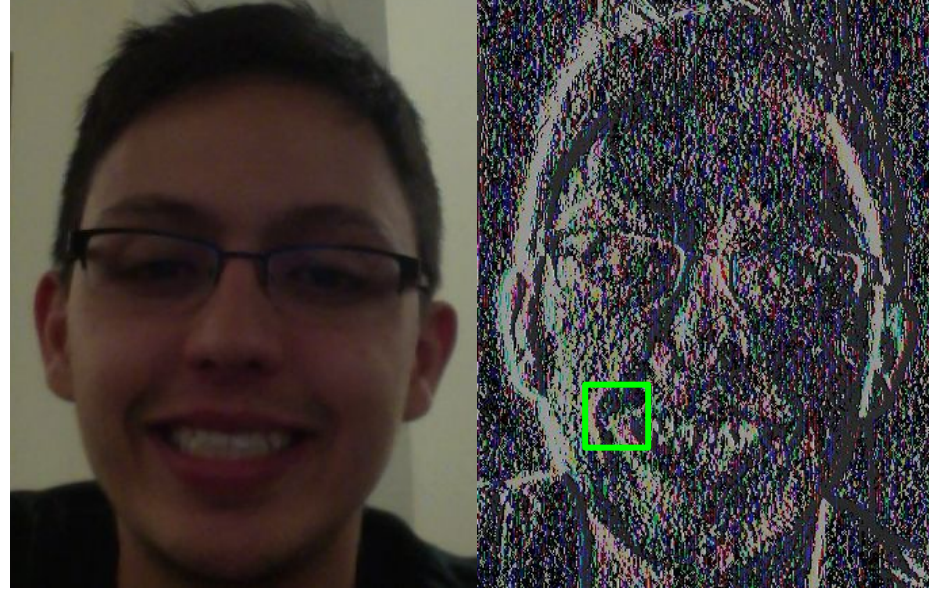
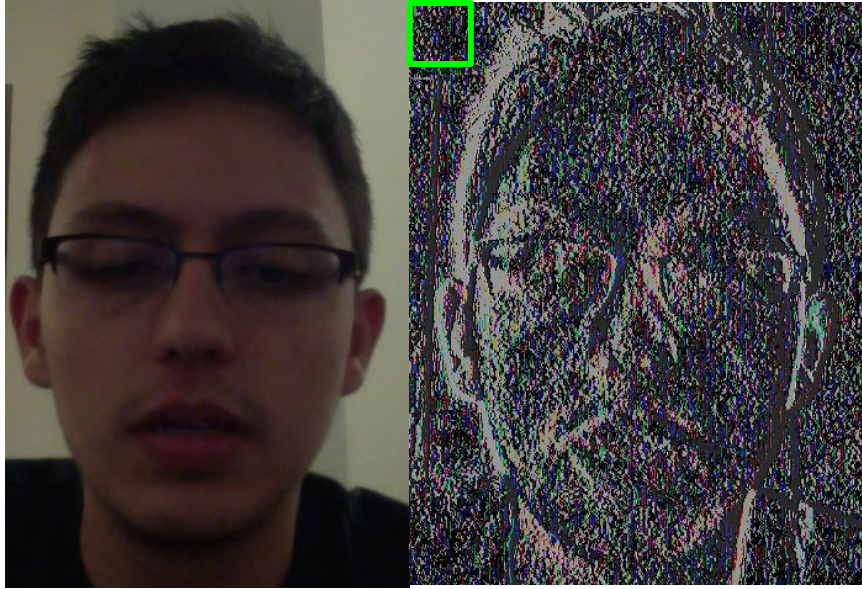
Preprocessing Block: Juan

8 bit LBP value

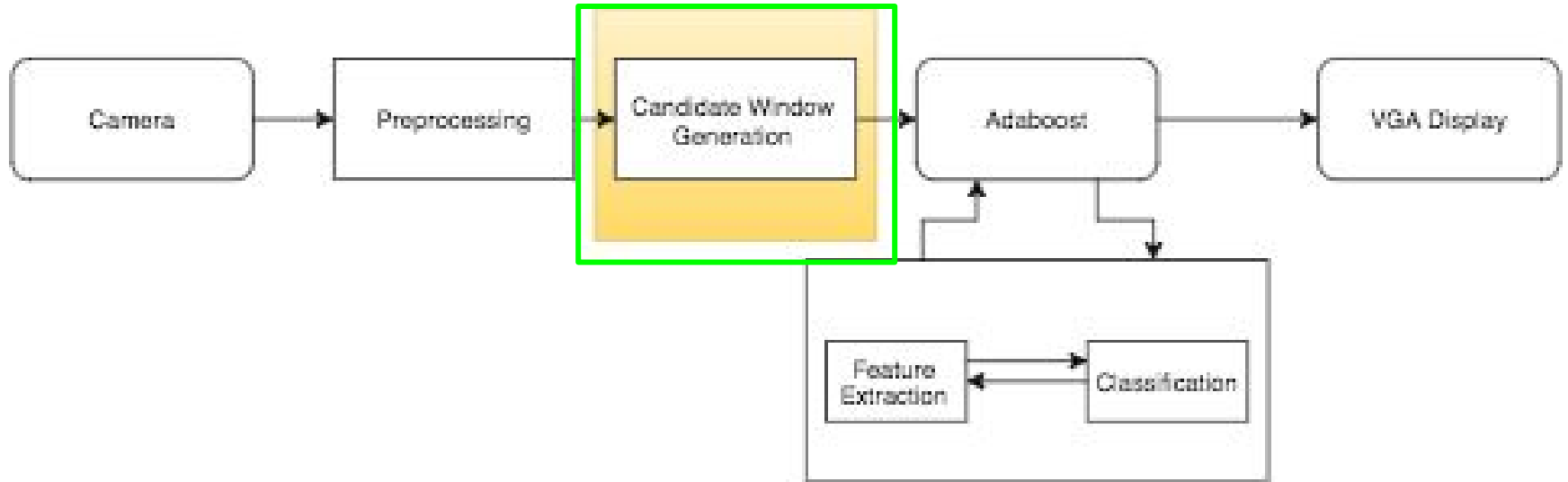


Crop to 150x128 px to limit data processed

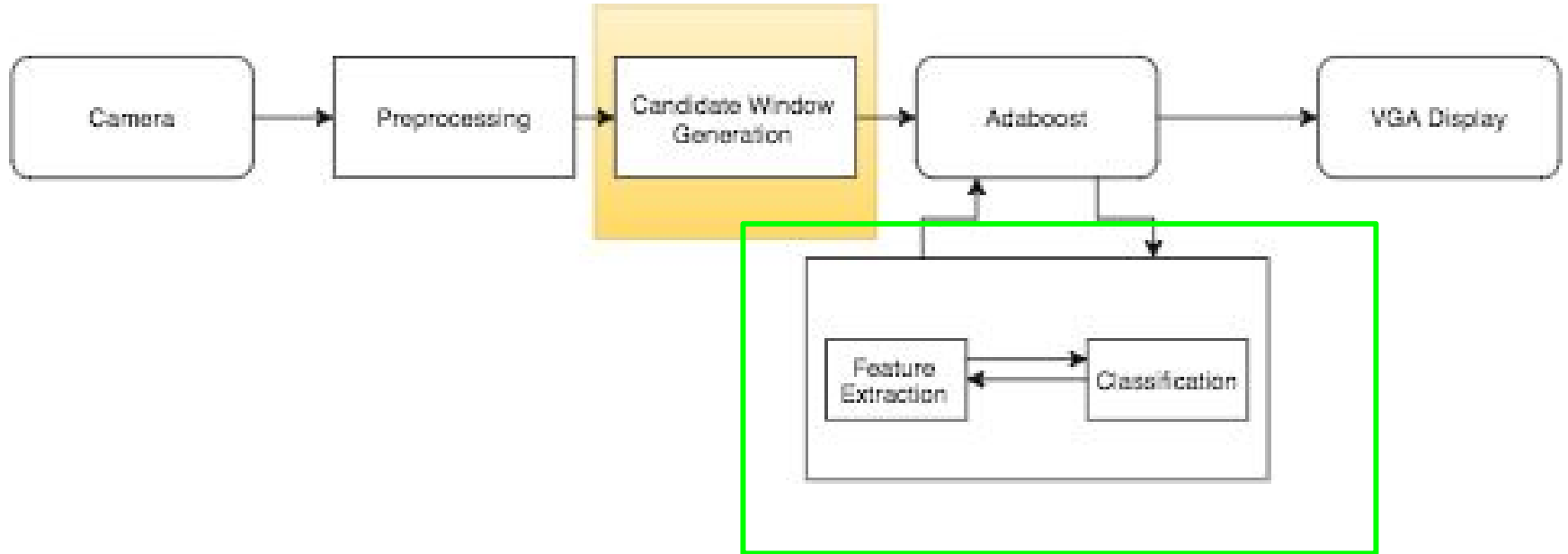
LBP- Local Binary Patterns (texture)



Stretch Goal: Sliding Window



Feature Extraction and Classification



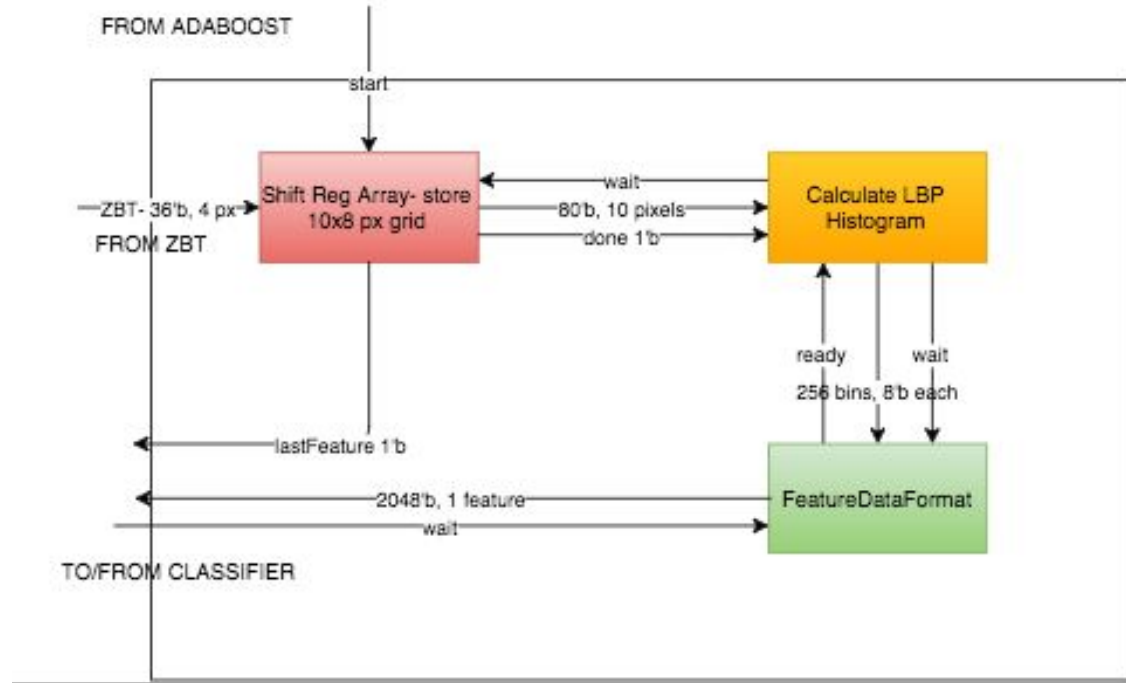
Feature Extraction: Juan

Sparse feature space rep

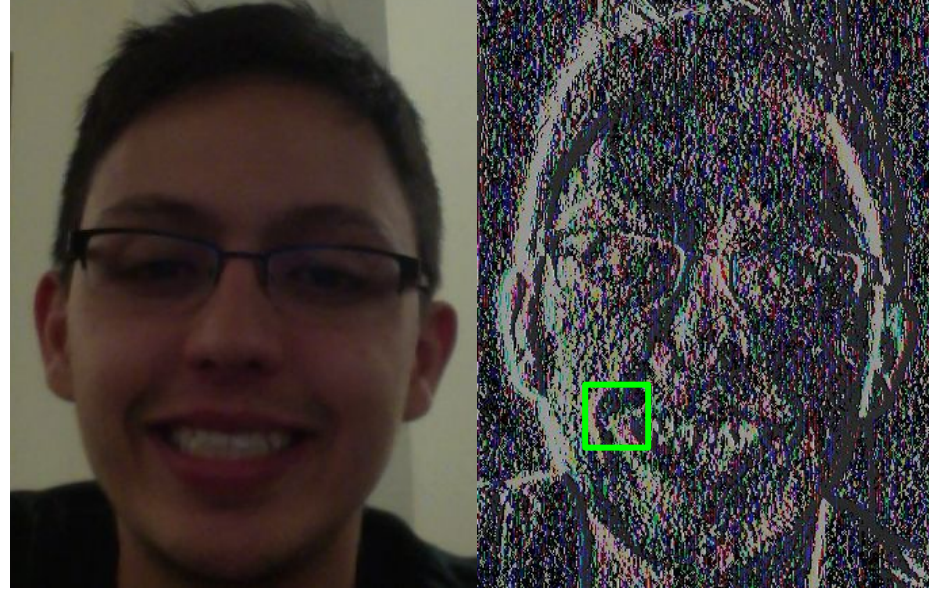
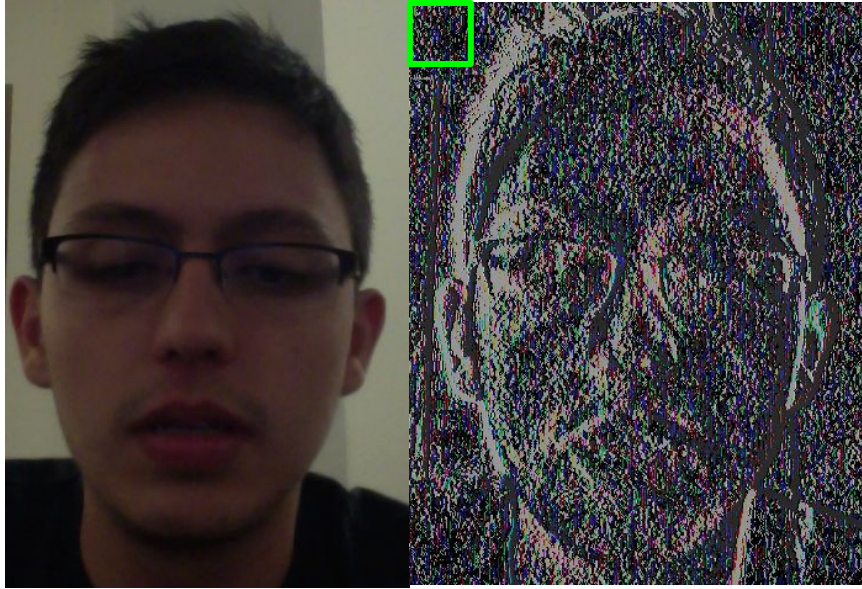
256 distinct LBP values

80 values per histogram

output is distribution of LBP/area



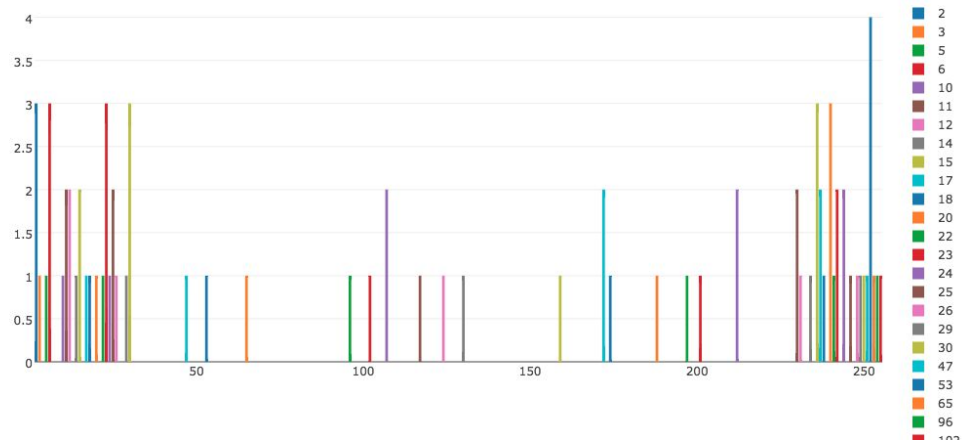
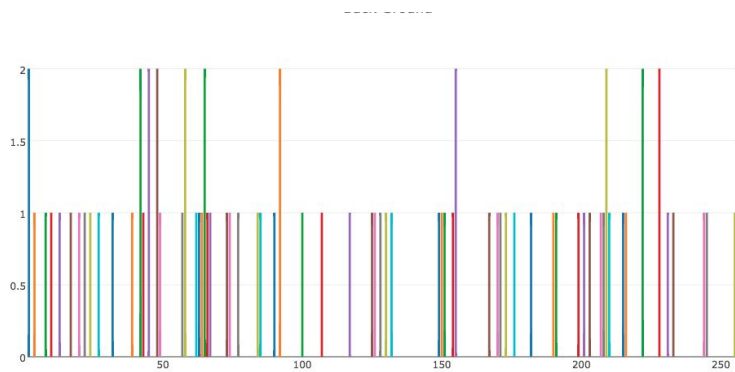
LBP- Local Binary Patterns (texture)



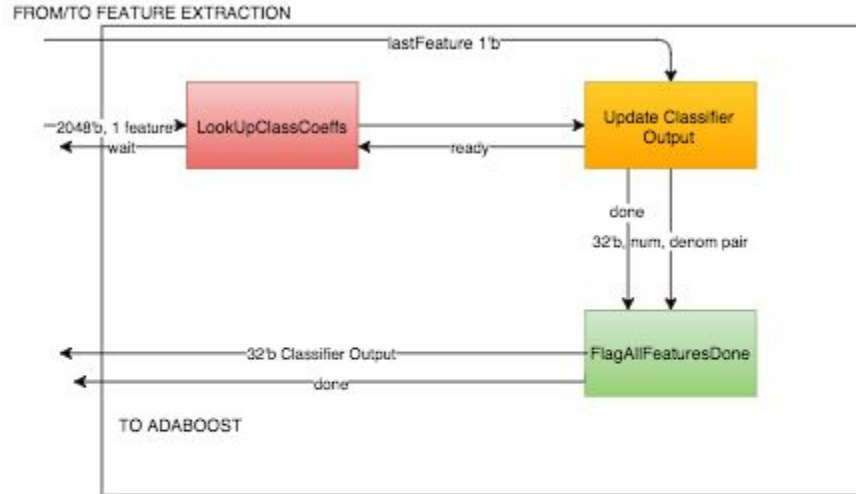
Background vs Face



LBP Histograms



Classification: Andres



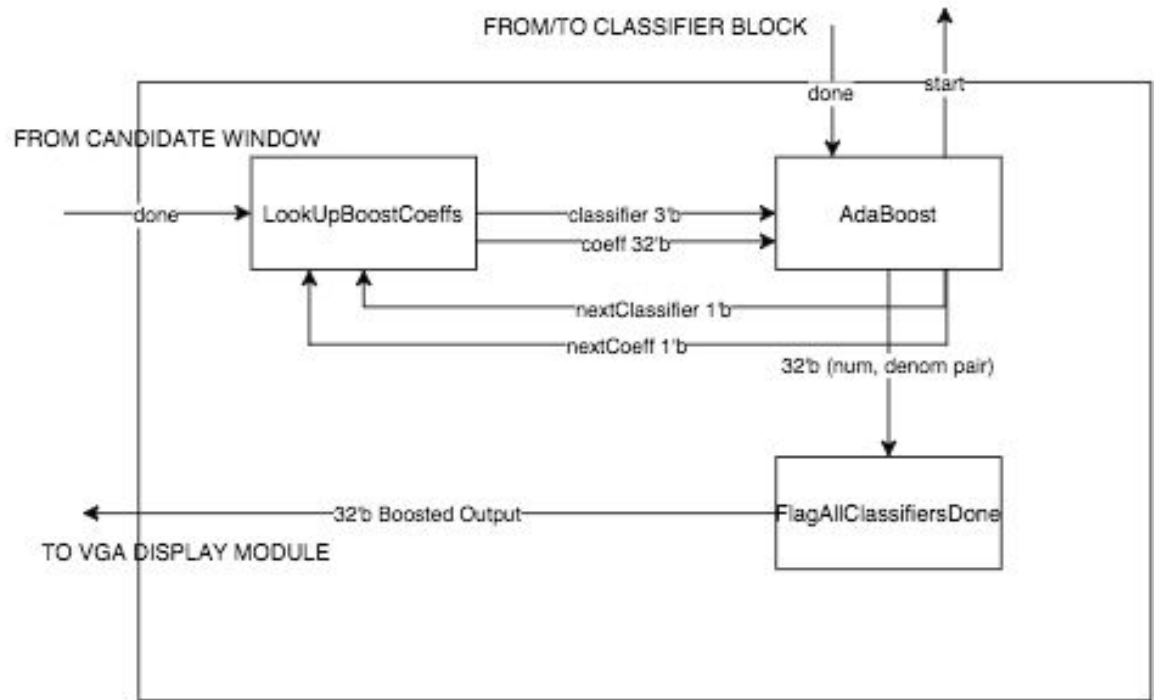
Decision Refinement: Andres + Juan

Adaboost

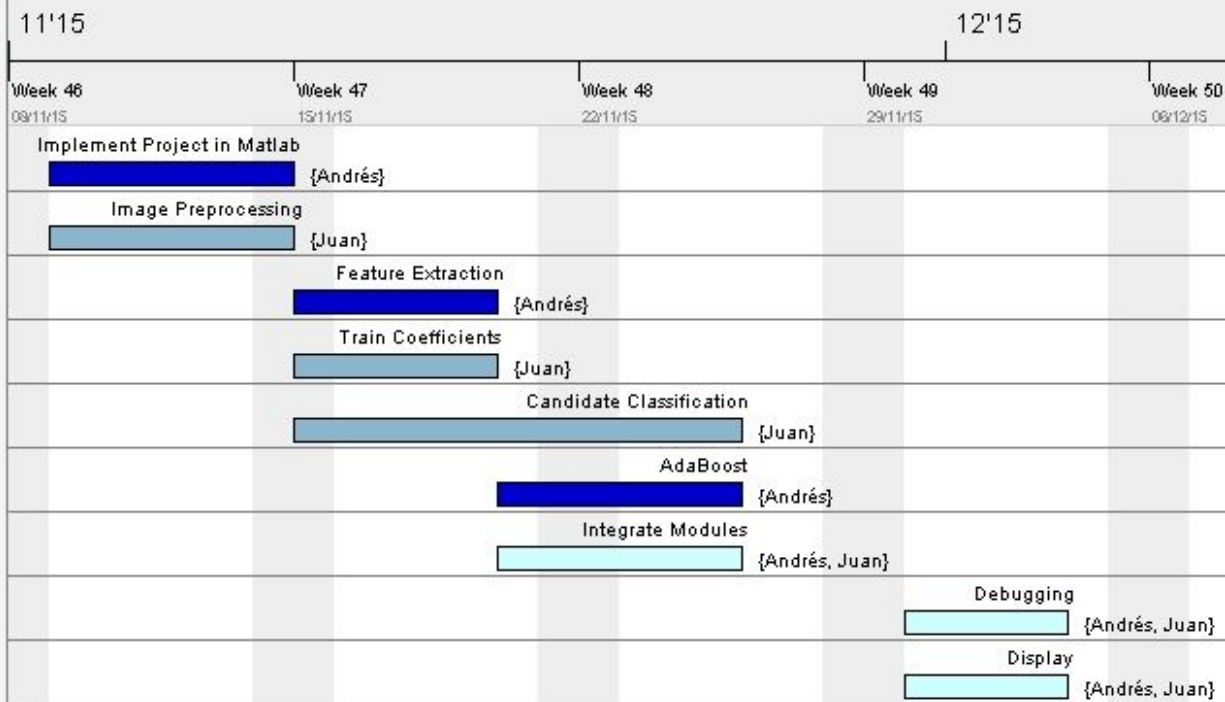
240 Subproblems

Weighted 'votes'

Boosts accuracy



Name	Begin date	End date
• Implement Project in Matlab	09/11/15	14/11/15
• Image Preprocessing	09/11/15	14/11/15
• Feature Extraction	15/11/15	19/11/15
• Train Coefficients	15/11/15	19/11/15
• Candidate Classification	15/11/15	25/11/15
• AdaBoost	20/11/15	25/11/15
• Integrate Modules	20/11/15	25/11/15
• Debugging	30/11/15	03/12/15
• Display	30/11/15	03/12/15





The kitchen once our project is completed

Questions?