Ubiquitous and Mobile Computing
AlcoWatch

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Worcester, we got a problem

“9,967 people were killed in drunk driving crashes in 2014” - www.intoxalock.com

“DUI’s Cost Drivers $6,500 on average”

- dui.drivinglaws.net

Related Work

- BACTrak Skyn
  - Uses Sweat
  - Dedicated device
- Smartwatch Gesture Sensing
  - Previous MQP
  - Allows recognition of “swig”

Smartphone vs. Smartwatch

- How to test Gait?
  - How do we accurately judge drunkenness?
  - What potential difficulties arise using a smartwatch over a smartphone
    - How does arm swing translate to body sway?
  - What potential gains from using a smartwatch?
    - A person uses their arms to steady themselves when they sway

Machine Learning

Oh boy!

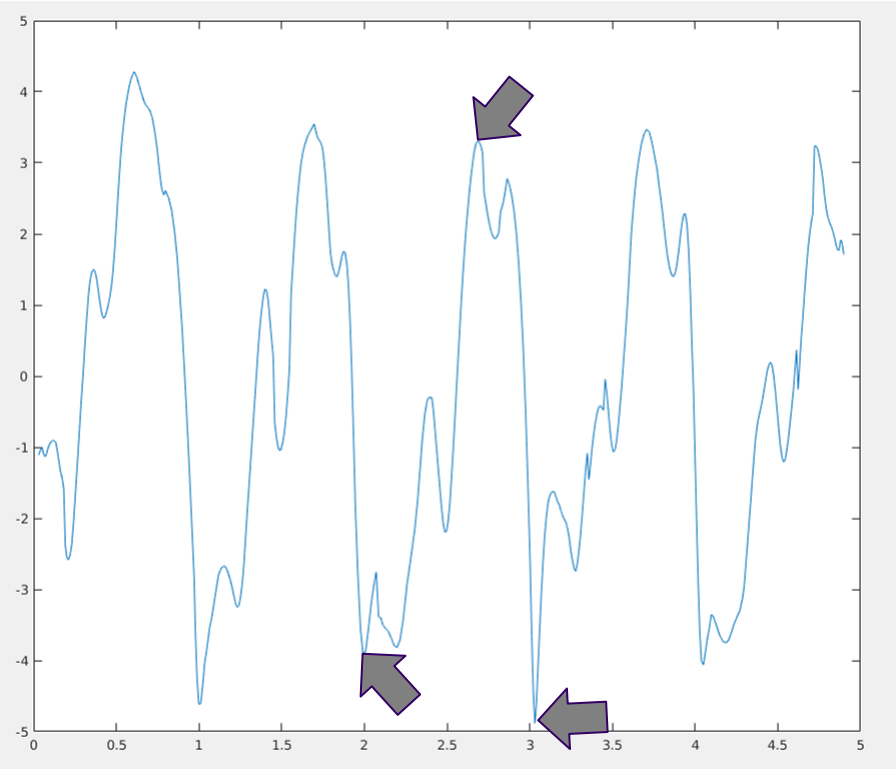
Gyroscope and Accelerometer give us Gait data

- Can get data from watch sensors
- Create formulas to generate features
    - Features from AlcoGait: swayAreas, swayVolume
    - Additional wrist-specific features
    - Segmenting features into forward/backward arm swing motion
- Use machine learning to judge BAC

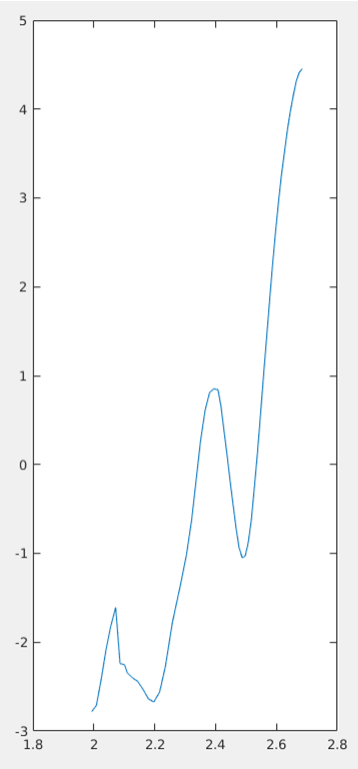
Wrist Features

- Roll Velocity
  - Speed at which user twists their wrist
- Horizontal, Vertical Displacement
  - Net displacement of wrist on the horizontal plane and vertically
- Roll, Pitch, Yaw Angular Displacement
  - Net angular changes about the X, Y and Z axes of the arm

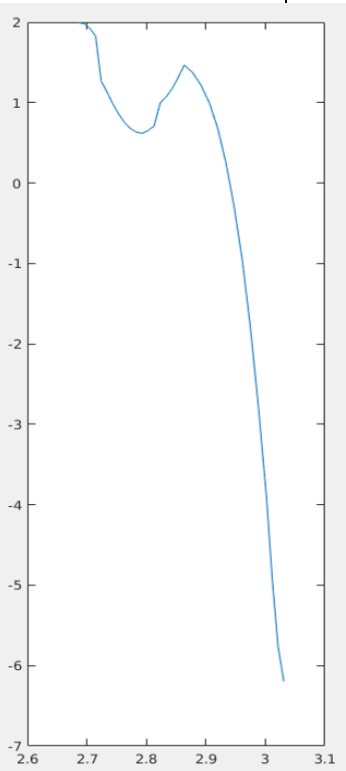
Segmenting Into Forward/Backward motion



Full Segment



Forward



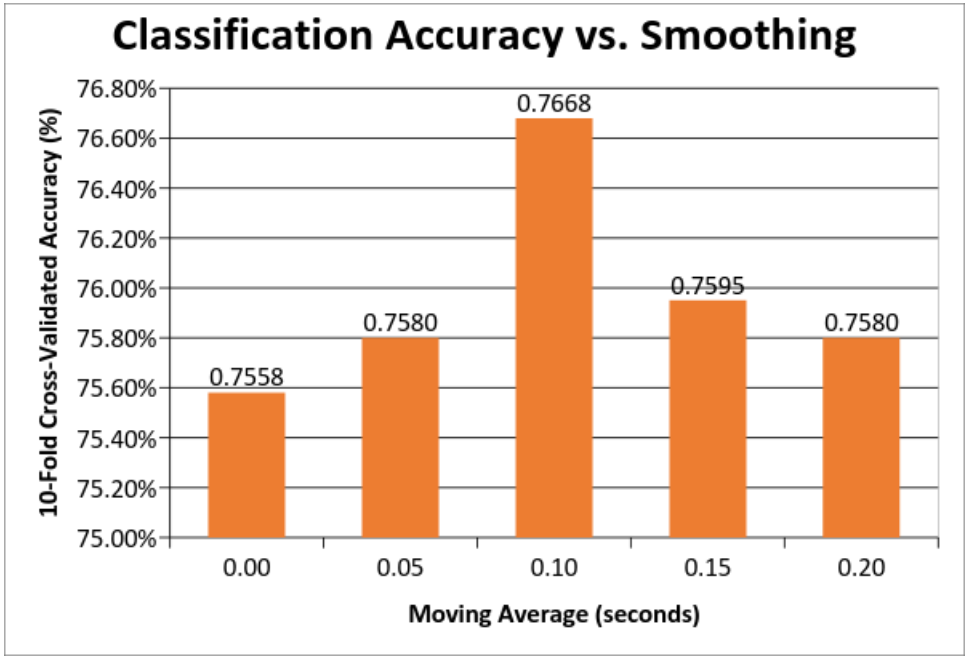
Backward

Feature Selection

- Compute correlation and p-value for each feature
  - Select if p-value < 0.05
- Others selected based on how they affect classification

Feature	Correlation	P-Value
yawVelVarianceForward	0.1877	0.00000
pitchVelMedianBackward	0.1720	0.00001
totalHarmonicDistortion	0.1642	0.00002
yawVelVarianceBackward	0.1522	0.00008
weight	0.1490	0.00011
yVelMedianForward	0.1467	0.00015
rollVelVarianceForward	0.1265	0.00107
pitchBackward	0.1247	0.00126
yawVelMedianBackward	0.1228	0.00149
bandpower	0.1215	0.00169
yzSwayArea	0.1198	0.00195
pitchVelVarianceBackward	0.1170	0.00250
xzSwayArea	0.1146	0.00305
xySwayArea	0.1130	0.00350
gender	0.0509	0.18964
height	0.0374	0.33457
age	0.0372	0.33760

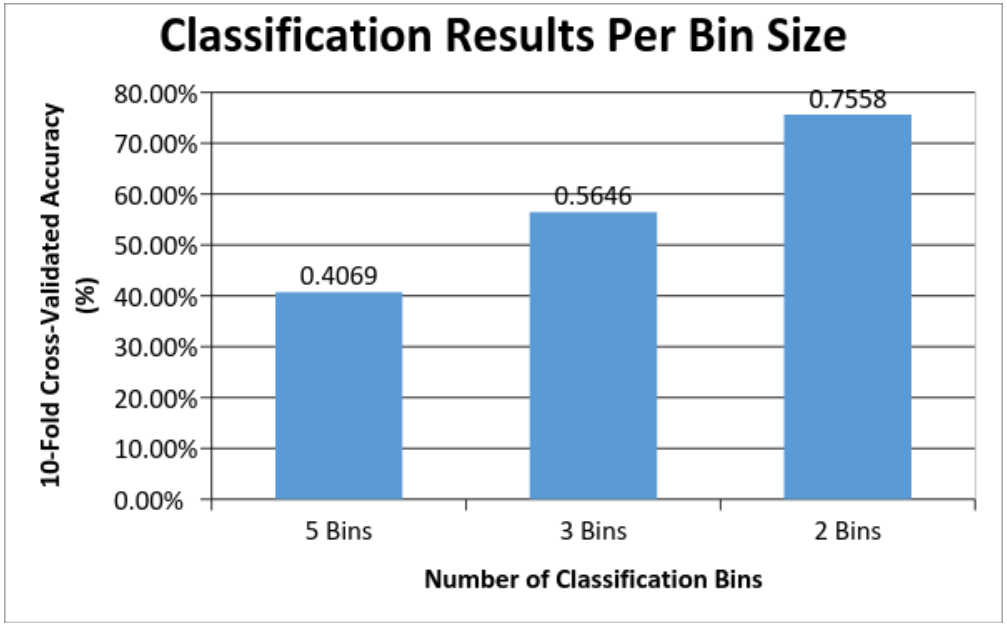
Smoothing



- Smoothing is a method of removing noise from data
- Compute a moving average across input
- Sometimes can improve performance

Number Of Bins

- To achieve a reasonable performance, might vary number of classification bins
- With a smartwatch, we use two bins for a “drunk” or “sober” detection

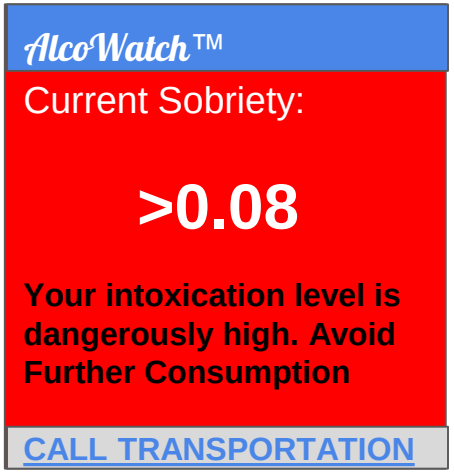


Different Classifiers

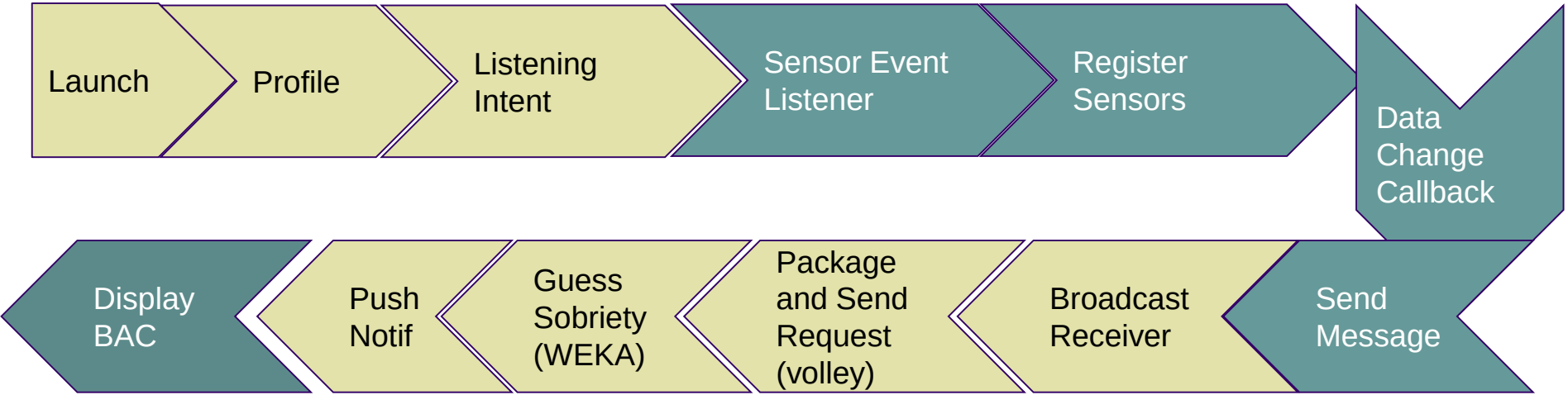
Classification Configuration		Results				
Classifier	Test Set	Accuracy	Precision	Recall	F-Measure	ROC Area
ZeroR	Cross Validation, 10 Folds	51.4620	0.265	0.515	0.350	0.496
J48	Cross Validation, 10 Folds	71.5643	0.716	0.716	0.716	0.745
J48	Percentage Split, 66% Train 33% Test	70.5376	0.707	0.705	0.706	0.737
Random Forest	Cross Validation, 10 Folds	76.5351	0.767	0.765	0.765	0.765
Random Forest	Percentage Split, 66% Train 33% Test	76.1290	0.772	0.761	0.761	0.846
Random Tree	Cross Validation, 10 Folds	64.7661	0.649	0.648	0.648	0.650
Random Tree	Percentage Split, 66% Train 33% Test	65.3763	0.655	0.654	0.654	0.661
JRip	Cross Validation, 10 Folds	67.8363	0.678	0.678	0.678	0.707
Bayes Net	Cross Validation, 10 Folds	61.5497	0.615	0.615	0.615	0.680
Bagging	Cross Validation, 10 Folds	72.8070	0.728	0.728	0.728	0.807

Visual Spec

Sleek, easy, and minimalistic



A Technical Overview



Thanks!

Any questions?