



Mentored by the Moving Stories Group

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### Project Objective

Teach a computer program simple human movements using machine learning, then utilize that data to process human movement in real time, identifying specific gestures, actions, and intentions.

### Approach

- To generalize the gestures, we separate movement into the 8 **Laban** Effort Actions: Float, Dab, Slash, Wring, Punch, Glide, Flick, Press
1. Capturing raw data by using Microsoft KINECT
  2. Pass the raw data into a feature extraction function.
  3. Use the Naïve Bayes algorithms to classify the the extracted features.
  4. Validate each feature function as a classifier with clustering, improving the accuracy.

### Status

```

posterior/right/F FF -0.27912 | 0.12048 | 0.38850
posterior/left/F FF -0.36483 | 0.22099 | 0.87893
posterior/F FF -0.02980 | -0.05216 | 0.28500
posterior/center/F FF -0.05272 | -0.10798 | 0.39558
posterior/back/F FF -0.02213 | -0.29624 | 0.40569
posterior/center/center/F FF -0.10283 | -0.04204 | 0.39343
posterior/back/F FF -0.07228 | -0.22826 | 0.33789
posterior/right/left/F FF -0.02748 | -0.28843 | 0.38896
posterior/left/left/F FF -0.02843 | -0.22826 | 0.33789
posterior/center/left/F FF -0.03488 | -0.07174 | 0.39558
posterior/right/right/F FF -0.12088 | -0.11767 | 0.34874
posterior/center/center/F FF -0.03808 | -0.04510 | 0.40221
posterior/left/right/F FF -0.11304 | -0.06022 | 0.39787
posterior/right/left/F FF -0.10884 | -0.18822 | 0.40588
posterior/center/center/F FF -0.10008 | -0.02228 | 0.34874
    
```

```

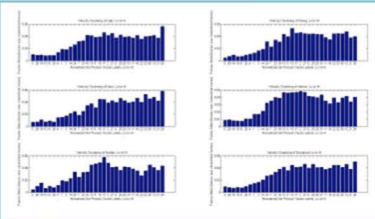
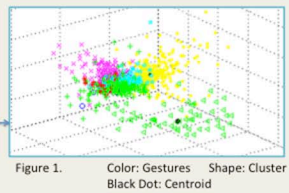
Step1. Raw data set (XYZ Position)
- Classifier Model: Naive Bayes
- Data: Raw data from MovingStories dataset
- Training set k: 0.7
- (optional) over-fitting: 20 folds cross validation
- Testing Gesture: 'Float', 'Flick', 'Slide', 'Dab', 'Wring', 'Slash', 'Press', 'Punch', 'Neutral'
- Train Gesture: 'Float', 'Flick', 'Slide', 'Dab', 'Wring', 'Slash', 'Press', 'Punch', 'Neutral'
- Features Extraction-Parameter list
Derivative parameter: Position, Velocity, Acceleration, Jerk
Bayesian covariance parameter: (diagonal, off-diagonal)
Linear algebra Features: Det, Cross, CrossMag, Theta
using FFT: window size: (must use same, 4)
    
```

### Step2. Feature Extraction Function

```

weight
Confusion matrix for total 6208 test frames:
conf =
 1485  3489
 1332  3985
Label 0: Accuracy = 0.52 | Precision = 0.49 | Recall = 0.53
Label 1: Accuracy = 0.53 | Precision = 0.59 | Recall = 0.57

Step3. Result (confusion matrix with all the features)
As the result shows, the Naive Bayes classification is poor. To improve the accuracy of classification, we need to validate each feature function to be on correct hyper plane.
    
```



Future Research:  
There are two alternative way to improve the result.

1. Using different algorithm for machine learning, such as Support Vector Machine(SVM), Hidden Markov's Model(HMM) etc..
2. Validate all of feature function and interpret meaning on classification.

### Questions

- What is the importance of classifying the human Action?
- What is the possible obstacle to predict the gestures?
- What is the real life application?

The figure 1, and figure 2's accuracy are not always better than accuracy of Naive Bayes. However, at least for specify efforts, it has better than Naive Bayes.

| Efforts   | Figure 1. | Figure 2. |
|-----------|-----------|-----------|
| Light     | 0.6839    | 0.5215    |
| Strong    | 0.6055    | 0.5221    |
| Direct    | 0.4680    | 0.4972    |
| Indirect  | 0.7770    | 0.6267    |
| Sudden    | 0.8002    | 0.5573    |
| Sustained | 0.5170    | 0.5250    |