STATE PREDICTION
BY ATTIRE RECOGNITION

Submitted in partial fulfillment of the requirements of DS 863 Machine Perception Course

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Abstract

The aim of the project is to retrieve information about the attire of a person in the input image.The objective is to identify the state the person in image belongs to based on the attire attributes fetched.

The work is multiclass classification and the final method chosen for classification uses decision tree combined with binary classification using bag of visual words.We have also tried various other methods initially like CNN , color histogram and bow on original image without any manipulations which gave poor results and thus we divided the project work into submodules to detect unique features each like silver head jwellery for kashmiris, distinct dress colors range for lucknowi ,white collared kurti on ghaghra for Haryanvi , dress length ratio for Punjabi and the remaining is gujarati .Each level of decision tree detects one unique feature from state and helps reach the final state prediction decision. For now we just have 5 state classification which have distinct as well as similar characteristics when it comes to attire and our aim is to accurately classify these based on the unique distinct features in the attire which represents a state .

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Motivation

Every country has its own cultural costumes. In Indian ethnic wear, silhouettes are mostly standard and basic; it concentrates more on printing techniques, surface ornamentation, intricate detailing, motifs and dyeing techniques.

In western wear, silhouettes are experimented and it concentrates more on shapes, textures, fabric manipulation, cuts and drapes.

Even in India every state follows different culture. States have their own festivals, language, songs, dance forms, food, believes and attire etc. These characteristics strongly defines a state of India.

One of the ways by which we can distinguish states from each other is from its traditional attire. Clothing in India varies depending on the different ethnicity, geography, climate and cultural traditions of the people of each region of India. India also has a great diversity in terms of weaves, fibres, colours and material of clothing. Colour codes are followed in clothing based on the religion and ritual concerned.

From our current work, we would like to predict the state/region from the image, depending upon what traditional dress person is wearing which may further help us determine characteristic properties of the person based on region to which he belongs.

Problem Statement

The project “State Prediction by Attire Recognition” is based on analysis of given input image. We initially need to classify 5 states namely:

- Haryana
- Uttar Pradesh, Lucknow
- Kashmir
- Punjab
- Gujarat.

The work is focused on attire classification. The broad objective of the project is to identify state (Indian) based on the traditional dress type of the person in input image. It is a multiclass classification problem.

Introduction

By predicting the state of the person, we can aim at extracting other possible information about a person. We can analyse things about a person like his food habits, climatic conditions that his body can sustain, language he might be able to talk in, cloth type and design preferences etc.

Analysing human based on the clothes they are wearing is a tough task but also a useful one. Thus, the project aims at predicting the state of the person based on the traditional attire he/she is wearing. To carry out this, we tried various methods which will be discussed once we introduce states based on attire its people wear:

Initially to train our model we have collected images from the following states as our dataset:

- Gujarat (Ghagara Choli)
- Haryana (Daaman, Chunder and Kurti/shirt)
- Jammu and Kashmir (Burkha, Pheran and Scarf on head (called Taranga))
- Uttar Pradesh (Chikkan work)
- Punjab (Punjabi salwar suit)

General Features of Gujarati Costumes

- Brightly coloured and Richly adorned costumes exhibiting intricate stone work, mirror work, bead work . Intricate designs, finesse, figurative, floral and geometric patterns are exhibited on the costumes
- Beautifully embroidered costumes showing stunning designs done with golden as well as silver zari threads
- Ornate jewelries and accessories offer the final touch to the typical Gujarati look
- The traditional costume of Gujarati women consists in the following items - Chaniyo, a richly colored and embellished petticoat Choli/Polku, a richly adorned blouse
- Odhani/Churni, a lightweight, transparent and decorated head cloth to add the final glamorous touch

General Features of Haryanvi Costumes

- The dresses of the Haryanvi's are usually very simple i.e. a dhoti, a shirt, a turban and a pair of shoes. Additionally, a Chaddar, a type of blanket, serves as a wrapper.
- A woman's dress is much more vivid and colourful than a male attire. A Jat woman's attire essentially consists of a *shirt*, ghagra and orhani which fall below the foreleg.
- The colour of dress of different communities is also unique to them. A Gujjar may therefore be differentiated from an Ahir woman, by the colour of the dress.
- Ornaments made of gold and silver are usually worn by men and women. Necklaces, bracelets, gold chains are usually worn on special occasions such as marriages etc.

General Features of Kashmiri Costumes

- The Pherans are the prominent attire for Kashmiri women, as well. Traditionally, there are the Poots and the Pherans, which includes two robes placed on top of the other. The Pherans worn by women usually has Zari embroidery done on the hem line, around the pockets and mostly done around the collar area.

- Females wear a headdress called the Taranga that is stitched to a suspended cap, and it narrows down at the back, towards the heels. Patterns in Brocade style can be found on their long sleeves.

- Women in Jammu and Kashmir also wear huge circular ear rings locally called kundalas, large anklets called nupura while in the Rajouri region a silver cap known as *chaunk phool* is worn on the head under the veil.

- The Pheran is usually worn alongside a red coloured head cloth known as the Kasaba. It is stitched like a turban and is pinned together by silver brooches and ornaments. A pin-scarf hanging from the Kasaba goes towards the shoulder.

General Features of Lucknowi Costume (chikankari)

- Chikankari is a very delicate and intricate shadow work type of embroidery. Initially, the embroidery was done using white yarn, on colourless muslins known as tanzeb.
- The word Chikankari has been derived from a Persian word Chakin or Chakeen, which means creating delicate patterns on a fabric.
- These are generally *dull coloured*, with *light colour* embroidery

General Features of Punjabi Costume

- The traditional dresses effortlessly merge style elements, comfort and colours.
- Salwar and Kameez is traditional costume of Punjab. They are usually of bright, dark and brilliant colours and are matched with a matching or contrasting coloured Dupatta.
- It is mostly shiny in texture and draped over the head as a part of their religious custom. Women also wear shawls which also come with beautiful Phulkari designs.
- Kameez are generally not loose and the fit to the skin closely.
- The length of the kameez is typically short, in comparison to other states.

By extracting one unique feature each from above general features we try to predict the state the person might belong to.

Brief Introduction of Methods and classifiers used

1. Bag of Visual Words (BOW)

Bag-of-words is a technique used in the field of computer vision for image classification. It draws a parallel between images and text documents. Image features are compared to words. In text classification, a vector is created for the counts of words. Similarly, in image classification, a vector called the bag-of-key points contains the dictionary of occurrence of local image features.
Csurka et. al. presented a novel method for image classification. This process has been designed to maximize classification accuracy and minimize computational cost. The steps involved in this process of categorization are as follows:

- **Detection And Description of Image Patches**: *SIFT features* have been selected for detection and description of image patches as they are robust to image rotation, scaling and illumination. They are vectors of 128 dimension.
- **Assignment of Patch Descriptors:** To reduce the large number of descriptors involved in computation, *K-means clustering* is performed. *(*k-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem.*)* Dictionary is created where the nearby descriptors are attached to the cluster centres. Whenever a new query arrives, each of its descriptors are assigned to the existing cluster centres. The dictionary of key points should be large enough to distinguish relevant changes in the image parts but not so large that noise starts affecting the categorization.
- **Construction of Bags of Keypoints:** The next step is to create a histogram for each image. This is created on the basis of number of occurrences of various keypoints (words) in the entire image.
- **Application of Multi-Class Classifier**: In the last step, a multi-class classifier is applied. The bag of keypoints are treated as features and categories are assigned to the images. Here, Support Vector Machines(SVM) has been used for classification using a linear kernel.

SVM uses the concept of finding the hyperplane which maximizes the margin between the support vectors.

2. Human Detection

OpenCV ships with a pre-trained HOG + Linear SVM model that can be used to perform human detection in both images and video streams. First, we make a call to *hog = cv2.HOGDescriptor()* which initializes the Histogram of Oriented Gradients descriptor. Then, we call the set SVMDetector to set the Support Vector Machine to be pre-trained human detector, loaded via the

cv2.HOGDescriptor_getDefaultPeopleDetector() function. We then handle loading our image off disk and resizing it to have a maximum width of 400
pixels. The reason we attempt to reduce our image dimensions is two-fold:
Reducing image size ensures that less sliding windows in the image pyramid need to be evaluated (i.e., have HOG features extracted from and then passed on to the Linear SVM), thus reducing detection time (and increasing overall detection throughput). Resizing image also improves the overall accuracy of our human detection (i.e., less false-positives). Detecting humans in images is handled by making a call to the detectMultiScale method of the hog descriptor. The detectMultiScale method constructs an image pyramid with scale=1.05 and a sliding window step size of (4, 4) pixels in both the x and y direction, respectively.

The size of the sliding window is fixed at 64 x 128 pixels. The size of the sliding window is fixed at 64 x 128 pixels, as suggested by the seminal Dalal and Triggs paper, Histograms of Oriented Gradients for Human Detection. The detectMultiScale function returns a 2-tuple of rects , or the bounding box (x,y)-coordinates of each person in the image, and weights , the confidence value returned by the SVM for each detection.

A larger scale size will evaluate less layers in the image pyramid which can make the algorithm faster to run. However, having too large of a scale (i.e., less layers in the image pyramid) can lead to humans not being detected. Similarly, having too small of a scale size dramatically increases the number of image pyramid layers that need to be evaluated. Not only can this be computationally wasteful, it can also dramatically increase the number of false-positives detected by the human detector. That said, the scale is one of the most important parameters to tune when performing human detection. We make initial bounding boxes and draw them on our image after this. However, for some images we notice that there are multiple, overlapping bounding boxes detected for each person. In this case, we have two options. We can detect if one bounding box is fully contained within another (as one of the OpenCV examples implements). Or we can apply non-maxima suppression and suppress bounding boxes that overlap with a significant threshold — and that's exactly what we do.
After applying non-maxima suppression, we draw the finalized bounding boxes on image and use this as input image to our further classifiers.

3. Face Detection

Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. OpenCV comes with a trainer as well as detector.Here we will deal with detection.

OpenCV already contains many pre-trained classifiers for face, eyes, smile etc. XML file 'haarcascade_frontalface_default.xml' contains them.

- First we need to load the required XML classifiers. Then load our input image (or video) in grayscale mode.

```
face_cascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')
```

- Now we find the faces in the image. If faces are found, it returns the positions of detected faces as

```
Rect(x,y,w,h)
faces = face_cascade.detectMultiScale(gray, 1.3, 5)
for (x,y,w,h) in faces:
    cv2.rectangle(img,(x,y),(x+w,y+h),(255,0,0),2)
    roi_gray = gray[y:y+h, x:x+w]
    roi_color = img[y:y+h, x:x+w]
```

4. CNN

A *convolutional neural network* is like a usual neural network. It also comprises of neurons, biases and weights. They take in an input, compute its dot product and optionally treat it with a non-linearity. Traditionally, a Convolutional Neural Network has convolutional layers followed by fully-connected layers. Its architecture is designed to take benefit of the two-dimensional nature of an image. It has a loss function on the last layer i.e. the fully connected layer. It is a feedforward neural network which is inspired by the animal visual cortex. It was created because the traditional networks were not invariant to linear translation. The types of layers present in a Convolutional Neural Network are as follows:

• INPUT
Input Layer contains the raw values of image pixels and three layers for Red, Green and Blue channels.

• CONV
Convolution layer computes the output of neurons that are locally connected to the input. They calculate the dot product between the pixel values of the connected input and their weights.

• RELU
This stands for Rectified Linear Unit. This layer introduces non-linearity in the architecture.

• POOL
The pooling layer is responsible for down sampling across height and width of the input matrix

• FC
The fully connected layer appears at the end of the network. It is used for computing scores for all the classes. The number of outputs at this layer correspond to the number of categories for classification. As the name suggests, every neuron of this layer is connected to every neuron of the previous layer.

5. Decision tree approach

In our final approach, we do something similar to decision tree building. Decision tree builds classification or regression models in the form of a tree structure. It breaks down a dataset into smaller and smaller subsets while at the same time an associated decision tree is incrementally developed. The result is a tree with decision nodes and leaf nodes. A decision node has two or more branches (we use binary), Leaf node represents a classification or decision. The topmost decision node in a tree which corresponds to the best predictor called root node. Decision trees can handle both categorical and numerical data.

6. KNN

K nearest neighbors is a simple algorithm that stores all available cases and classifies new cases based on a similarity measure.

Algorithm
A case is classified by a majority vote of its neighbours, with the case being assigned to the class most common amongst its K nearest neighbours measured by a distance function. If K = 1, then the case is simply assigned to the class of its nearest neighbour.

Distance functions

Euclidean $$\sqrt{\sum_{i=1}^{k}(x_i - y_i)^2}$$

Manhattan $$\sum_{i=1}^{k}|x_i - y_i|$$

Minkowski $$\left(\sum_{i=1}^{k}(|x_i - y_i|)^q\right)^{1/q}$$

7. LinearSVC

Linear Support Vector Classification.
Like SVC with parameter kernel='linear', but implemented in terms of liblinear rather than libsvm, so it has more flexibility in the choice of penalties and loss functions and should scale better to large numbers of samples.
This class supports both dense and sparse input and the multiclass support is handled according to a one-vs-the-rest scheme.

Along with this we have developed modules namely:

- Upper Body Dress Colour Detection
- Forehead Silver Jewellery Detection
- Collar Detection
- Patiyala vs Lehenga

Various Approaches and Analysis

Approach 1: Colour histogram as feature and LinearSVC Classifier.

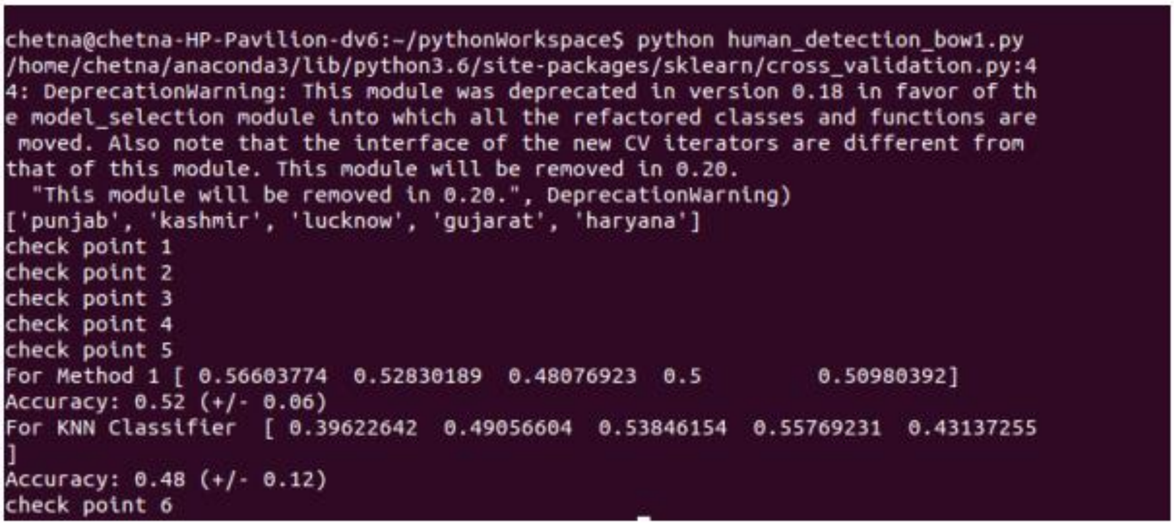
In this approach we form color histogram from the image pixels and give it to our classifier(LinearSVC,KNN) as a feature that defines the image. Accuracy obtained via color histogram quantization is 43% and 45% respectively.

Approach 2: Bag of Visual Words as feature vector and LinearSVC Classifier, KNN Classifier.

We first obtain (100) cluster Centres using K-Means Algorithm. We then form histograms of features of image using these centres and thus pass this bag of visual words obtained to train our classifier. Accuracy obtained via BagOfVisualWordsApproach is 46%.

Approach 3: Human Detection + Bag of Visual Words

We thought that above approach would be extracting unnecessary features of background so we first applied human detection on our dataset, extracted this as new image input for finding descriptors and key points but it did not make a significant difference and accuracy obtained was 48%.



```
chetna@chetna-HP-Pavilion-dv6:~/pythonWorkspace$ python human_detection_bow1.py
/home/chetna/anaconda3/lib/python3.6/site-packages/sklearn/cross_validation.py:4
4: DeprecationWarning: This module was deprecated in version 0.18 in favor of th
e model_selection module into which all the refactored classes and functions are
 moved. Also note that the interface of the new CV iterators are different from
that of this module. This module will be removed in 0.20.
  "This module will be removed in 0.20.", DeprecationWarning)
['punjab', 'kashmir', 'lucknow', 'gujarat', 'haryana']
check point 1
check point 2
check point 3
check point 4
check point 5
For Method 1 [ 0.56603774  0.52830189  0.48076923  0.5         0.50980392]
Accuracy: 0.52 (+/- 0.06)
For KNN Classifier  [ 0.39622642  0.49056604  0.53846154  0.55769231  0.43137255
]
Accuracy: 0.48 (+/- 0.12)
check point 6
```

Approach 4: Convolutional neural network using ALEXNET

Accuracy obtained by using CNN is : 95%

All above codes use *cross validation* method to fetch accuracy.

Final Approach State Classification by individual unique feature detection as a Module

Since above approaches did not give us satisfactory results we decided to work on individual feature which could uniquely identify a state and thus help in predicting the state that is represented by image.

Features and States

- **Module 1: Upper Body Dress Colour Detection : Lucknow**
- **Module 2: Silver Jewellery Covering Major Forehead : Kashmir**
- **Module 3: Collar Detection : Haryana**
- **Module 4: Patiyala vs Lehenga : Punjabi, Gujarati**

Procedure Explanation

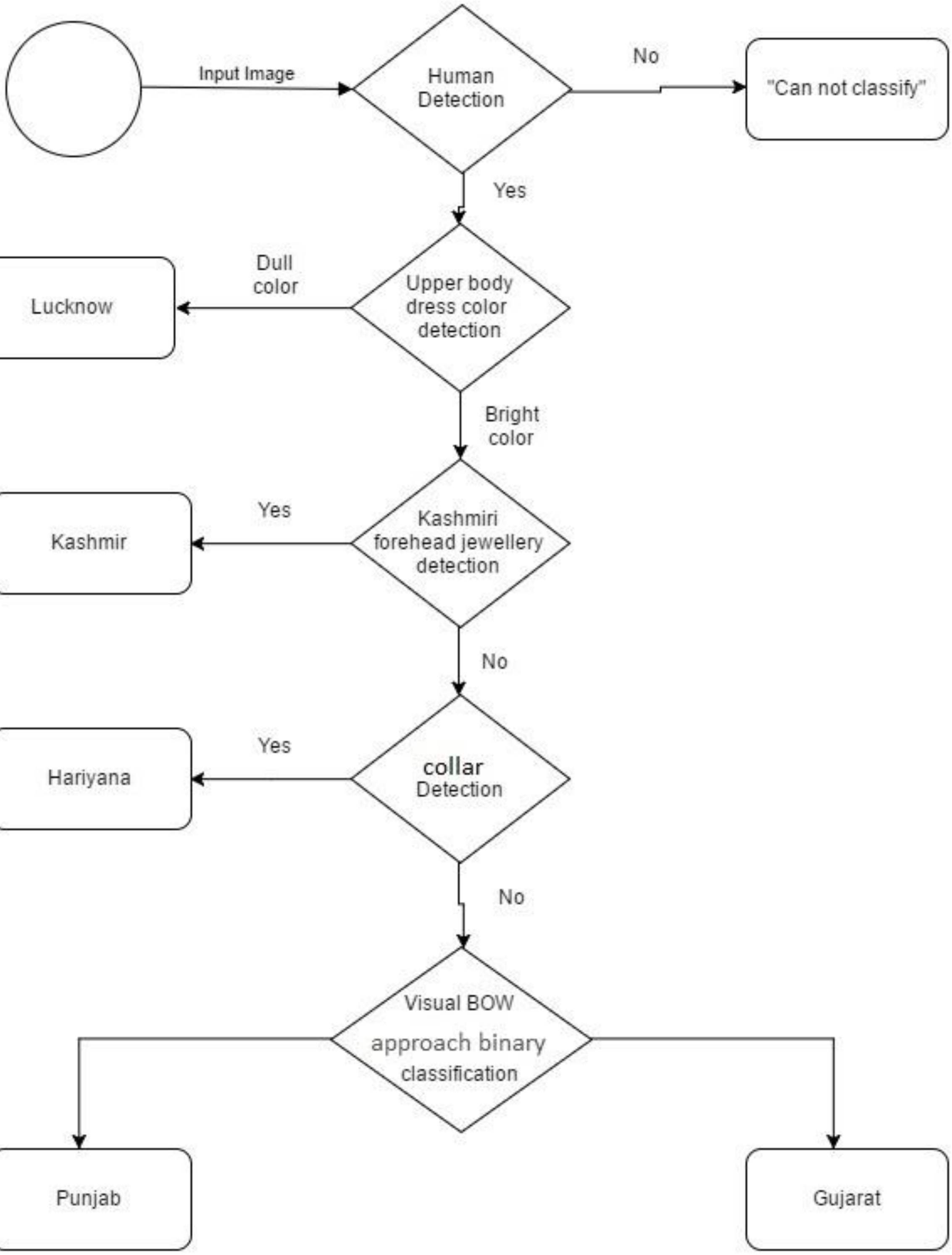
Digging deeper into dataset for states, we found that each state had one unique feature that could help detect that state from others (One Vs rest) which will help improve accuracy of project model approach and thus in order to learn various techniques and add on our own logics we decided to work on these features. For predicting state of given input, we decided to follow the steps shown in below flow chart.

We first extract human from the given image using human Detection Algorithm which uses harcascade and pass this as our image to work on to different modules. If we can detect a human we first check if the dress the person is wearing is Lucknow or not. This is done by first extracting a patch of dress and using hsv colour range mapping. (All modules explained in detail later under submodule section). The colour code range for Lucknow dress is unique and gives a very high accuracy.

If the image belongs to Lucknow attire its classified here and program finishes else we go for face detection which will help us classify Kashmir or Haryana. Once face is detected we run the code for forehead jewellery detection, if detected we classify it as Kashmiri as silver jewellery covering entire forehead (silver chaunk phool) is unique to Kashmiri attire. If not Kashmiri we then check if below the face, does the dress has white collar in it, as this is a unique feature in Haryanvi woman traditional dresses who wear a white collared shirt, ghagra and orhani. Here we detect region of interest i.e. the area of collar and then using bag of words approach train a classifier to predict whether collar is present or not.

If not this we then apply BoW approach using KNN and linearSVC classifiers and predict whether the dress is Punjabi or Gujarati which become as a binary classification problem.(we tried various approaches before applying this, like We tried coding a module for dress length calculation that detects edges , then trying to find out dress length of the upper body dress and lower , which we saw was a distinct feature between punjabi dress and gujarati dress, but were not able to complete the module as the detecting the horizontal line that separates the upper body dress vs lower body dress wasn't an easy task)

Project Approach Flow Chart



Module Descriptions

Module 1: Upper Body dress color detection:

1. Detect human bounding box
2. Convert it to HSV image
3. Extract a rectangular patch from center of upper body dress

This region is found by applying mathematical operations on human bounding box:

height, width = img.shape[:2]
midh=np.int(height/2)   # vertical center of image box
midw=np.int(width/2)   # horizontal center of image box
temph= np.int(height/4)   # for defining width of rectangular patch
tempw= np.int(width/4)   # for defining length of rectangular patch
x= midw - np.int(tempw/2) # x coordinate of rectangle (parameter required to construct rectangle)
y= midh - np.int(temph/2)   # y coordinate of rectangle (parameter required to construct rectangle)
w=tempw   # width of rectangle
h=temph   # height of rectangle

4. We now define ranges for lucknowi dress colour which helps uniquely identify the state

#range one
#H - full range   S - 0% to 15%   V - 75% to 100%
lower1 = np.array([0,0,190])
upper1 = np.array([179,40,255])

#range two
#H - full range   S - 0% to 23%   V - 80% to 100%
lower2 = np.array([0,0,205])
upper2 = np.array([179,60,255])

#range three
#H - full range   S - 0% to 38%   V - 95% to 100%
lower3 = np.array([0,0,242])
upper3 = np.array([179,95,255])

5. We know assign pixels in extracted rectangle value 255(White) if they lie in above ranges else we mark them 0(Black)
6. If count of white pixels is more than black we predict it as Lucknow dress.

The above code provides very good accuracy.


original
humans detec
Lucknow

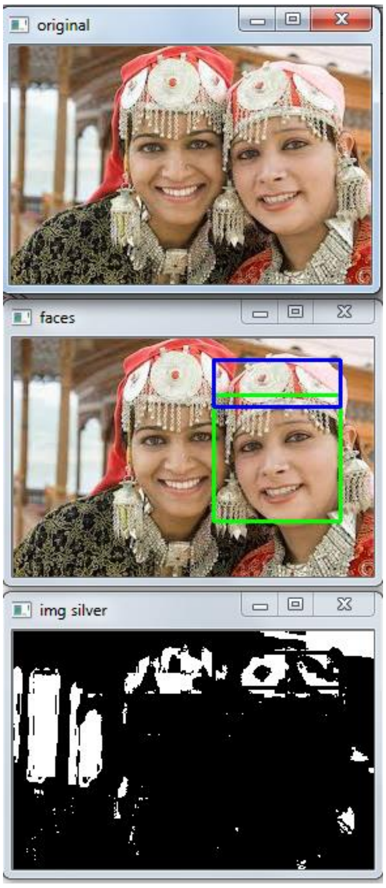
MODULE 2: Detecting Kashmiri Forehead Jewellery

Women in Jammu and Kashmir wear huge circular ear rings locally called kundalas, large anklets called nupura while in the Rajouri region a silver cap known as chaunk phool is worn on the head under the veil.
Here we focus on predicting whether the lady is wearing "chaunk phool" or not (mainly silver color). In the dataset collected, kashmiri ladies are wearing silver chaunk phool

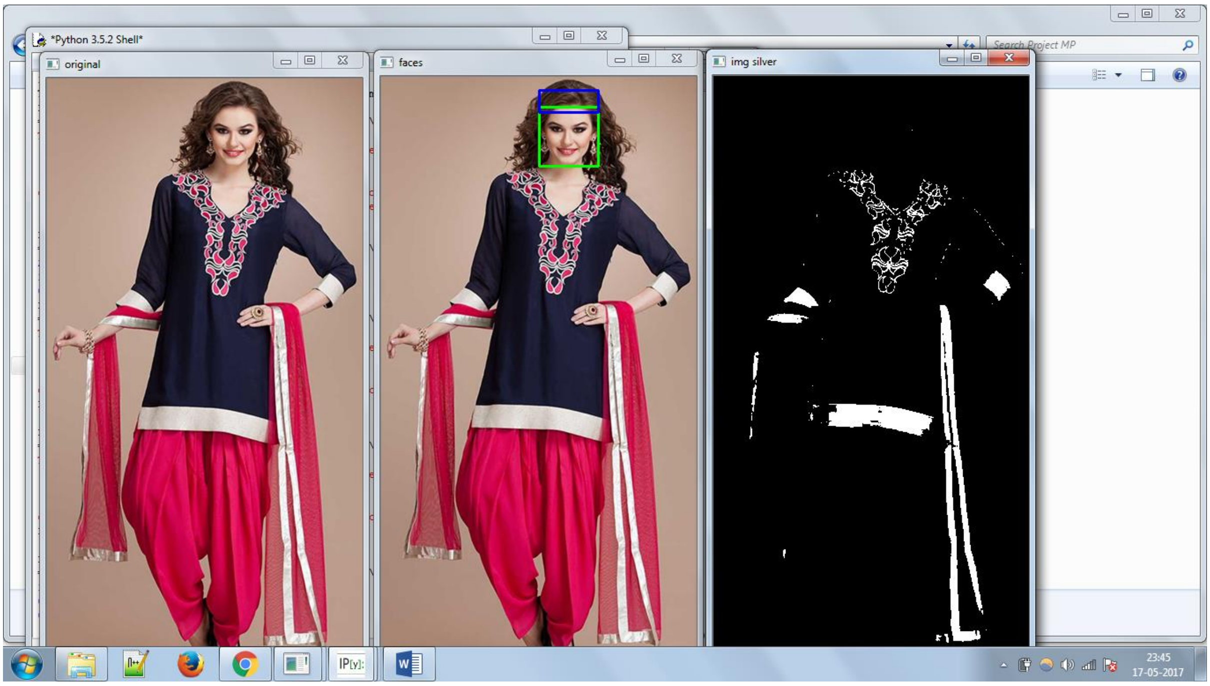
Steps for detecting the jewellery:

1. Detect face in the images using “haarcascade_frontalface_default”
2. This will give a square containing face of the lady; the ornament is just above the face.
3. Take a small rectangle above the face; depending upon the size of square, the size of rectangle is:
Length of rectangle=1/4th of square
Width of rectangle=width of square
Convert the image to HSV
4. Take a range of values in HSV which represents silver colour:
H in range: 0 to 180
S in range: 0 to 21
V in range: 125 to 255
5. Convert all the silver pixels to white and rest of the pixel values to black
6. In the rectangle if more than 30 percent of the pixels are white then we can say that the lady is wearing chaunka phool, else she is not.
7. Using this we can detect wearing head ornament is present in the image of or not.

Silver Jewellery present



No silver jewellery



Challenges faced:

In some of the images the ornament is not purely silver, and it has golden touch, at that time the ornament does not comes under the range specified above.

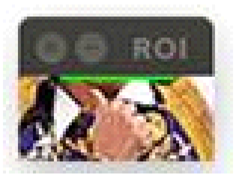
Face detection algorithm detects only frontal face and not side faces.

MODULE 3: Collar Detection

Strategy: Selected BOW approach

Training phase:
1. For each training image, we have done:
I. Face detection:

II. Extracting Region of Interest and apply thresholding:



III. Extract SIFT descriptors from thresholded ROI

2. After collecting descriptors of all images, we applied K-means clustering.
3. created histogram for each image and assigned them to the cluster
they are nearest to.
4. Trained KNeighborsClassifier model.

Testing phase:
1. Extract ROI from test image

Input Image:

ROI extraction and thresholding:

2. Also extract SIFT descriptors from ROI of the test image.
3. Trained model will classify the test image (collar or non-collar).

```
['D:\\IIIT BANGALORE MTech\x02nd SEM\\MP\\Project MP\\test\\']
QQQQQQQ 0
[[ 4.  1.  0.  0.  1.  0.  0.  1.  0.  2.  0.  0.  2.  0.  1.
   0.  2.  3.  0.  0.  1.  0.  0.  0.  1.  0.  3.  0.  1.  2.
   0.  0.  0.  4.  0.  1.  4.  1.  0.  0.  0.  3.  1.  0.]]
OUTPUT IS  ['Collar']
```

Non-collar input image:

Extracting ROI and thresholding it:

Output:

```
['D:\\IIIT BANGALORE MTech\x02nd SEM\\MP\\Project MP\\test\\']
QQQQQQQ 0
[[ 1.  0.  0.  0.  2.  1.  4.  0.  3.  0.  0.  0.  0.  4.  1.  0.  0.  4.
   0.  0.  0.  3.  0.  0.  1.  3.  0.  0.  0.  1.  0.  0.  2.  0.  0.  2.
   0.  0.  0.  2.  1.  0.  1.  4.  0.  2.  2.  0.  1.  0.]]
OUTPUT IS  ['Non Collar']
```

MODULE 4: Patiyala vs Lehenga

1. To train our classifier we first detect human in dataset images. Then we extract only the lower body of human by dividing the detected human body from Height/2. Then we apply bag of visual words approach on this.

2.Detection and Description of Image Patches
SIFT is used as keypoint detector and descriptor. The output is vectors of 128 dimension.

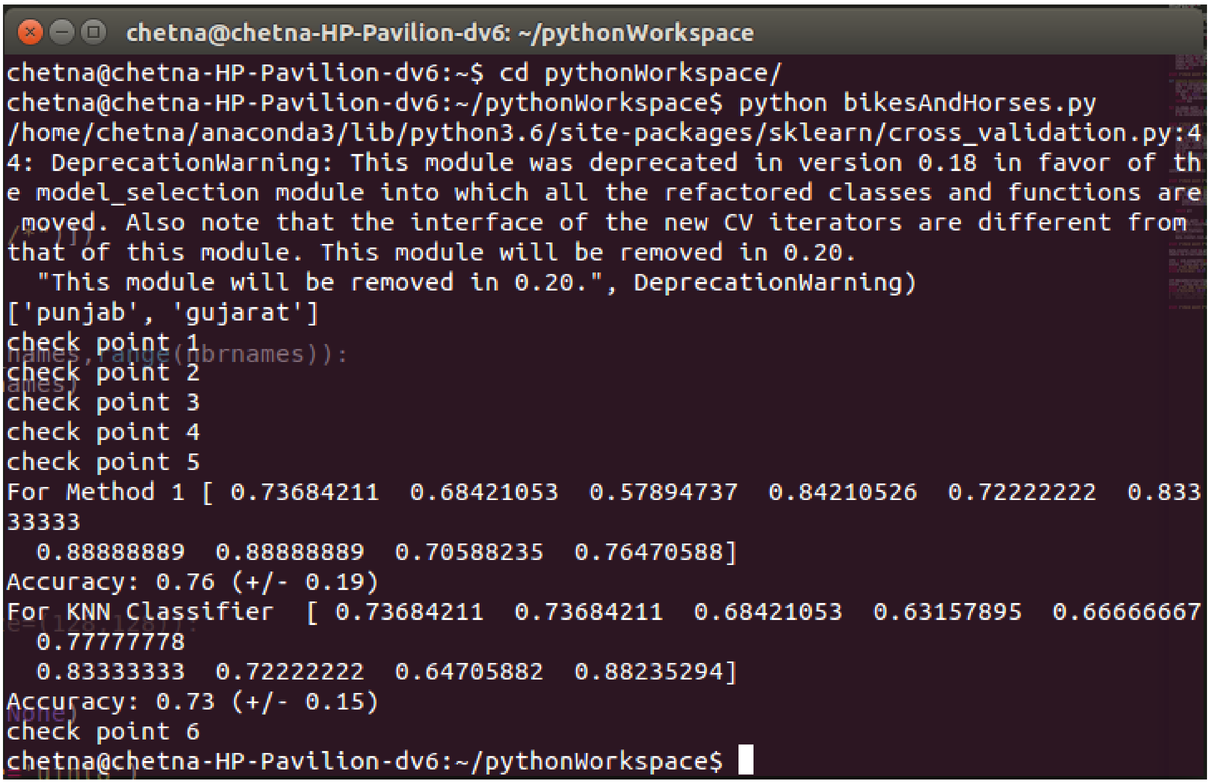
3.Calculation of Cluster Centres from the descriptors found
To reduce the considerable number of descriptors involved in computation, K-means clustering is performed. From the set of descriptors k cluster centres are found. K chosen is 100.

4.Construction of Bags of Visual Words
For each image now, dictionary is created where the nearby descriptors are attached to the cluster centres and count for corresponding centre increments by one.

5.Application of Classifier
In the last step, a binary classifier is applied to predict whether state is Punjab or Gujarat. Same procedure is followed, lower half of input image is taken and corresponding BoWs is formed. The bag of key points is treated as features and categories are assigned to the images.
Here, accuracy via two classifiers have been calculated:

a) LinearSVC,
b) KNN Classifier.

KNN gives better output.



```
chetna@chetna-HP-Pavilion-dv6: ~/pythonWorkspace
chetna@chetna-HP-Pavilion-dv6:~$ cd pythonWorkspace/
chetna@chetna-HP-Pavilion-dv6:~/pythonWorkspace$ python bikesAndHorses.py
/home/chetna/anaconda3/lib/python3.6/site-packages/sklearn/cross_validation.py:4
4: DeprecationWarning: This module was deprecated in version 0.18 in favor of th
e model_selection module into which all the refactored classes and functions are
 moved. Also note that the interface of the new CV iterators are different from
that of this module. This module will be removed in 0.20.
  "This module will be removed in 0.20.", DeprecationWarning)
['punjab', 'gujarat']
check point 1
check point 2
check point 3
check point 4
check point 5
For Method 1 [ 0.73684211  0.68421053  0.57894737  0.84210526  0.72222222  0.833
33333
  0.88888889  0.88888889  0.70588235  0.76470588]
Accuracy: 0.76 (+/- 0.19)
For KNN Classifier  [ 0.73684211  0.73684211  0.68421053  0.63157895  0.66666667
  0.77777778
  0.83333333  0.72222222  0.64705882  0.88235294]
Accuracy: 0.73 (+/- 0.15)
check point 6
chetna@chetna-HP-Pavilion-dv6:~/pythonWorkspace$
```

- ➔ **All four modules developed can be applied to other projects too as per the need and are generic**

Conclusion

Thus, by applying step by step procedure on input image we can predict the state that the traditional costume in image represents.

Future Work

- The project can be extended to predict other states in future like Kerala, Mizoram etc.
- We can further use body parts detector and improve efficiency by picking few more features of each state.
- Other modules can also be developed to detect further features and can be used as generic detectors ex:
- Saree Detection along with border colour Detection.
- Dress Fitting.

References

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- Histograms of Oriented Gradients for Human Detection Navneet Dalal and Bill Triggs
- Various research paper regarding face detection , human detection, upper body detection, SIFT , SURF