(c) Centroid

The Centroid feature is shown in **Figure 2**

i. Find the centre of image block.
ii. Find the distance from centre of image block to all the corner points.
iii. Find minimum and maximum distances form calculated distances.
iv. Find ratio of maximum distance/minimum distance.
v. For Shot Change Detection:

a. Centroid Ratio1(Frame 1):

(MaximumDistance)/(Minimum Distance)

b. Centroid Ratio2(Frame 2):

(Maximum Distance)/(Minimum Distance)

vi. Difference between the two frames:
a. Euclidian Distance = Sqrt(((Centroid Ratio1 – Centroid Ratio2)*(Centroid Ratio1 – Centroid Ratio2)))
vii. If the Euclidian Distance >□, shot change is detected.
viii. Otherwise no shot change is detected.

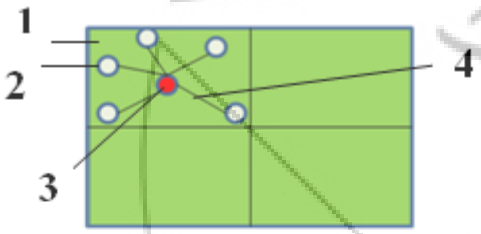

Figure 3: Centroid

Where,

1 → Image Block

2 → Corner point

3 → Centroid corner point

4 → Distance from centroid to all corner points

(d) Polygon

i. Find the corner points which has minimum distance for left, right, top and bottom line of the image block.
ii. Draw a polygon by joining all the four points.
iii. Find the inner angle of polygon.
iv. Find the ratio of : (area of inner box)/ (area of image block).
v. Find the ratio of: (maximum angle) / (minimum angle).
vi. Angle of polygon= Area of Rhombus= a*b*sin□□

a= distance between x1 and x2.
b=distance between x1 and x4.
dx1= (x2-x1), dy1= (y2-y1),
dx2= (x3-x1), dy2= (y3-y1)
m1= sqrt((dx1*dx1)+(dy1*dy1))
m2= sqrt((dx2*dx2)+(dy2*dy2))
□=acos(dx1*dx2+dy1*dy2)/(m1*m2)*(180/ π)
vii. Area of polygon= (0.5*b*h),
b= distance between x1 and x3,
h= distance between x2 and x4.
Area of Image block = Block Width * Block Height
viii. For shot change detection:
a. Take the difference of Euclidian distance between angle and area ratios of two frames as specified in step 3 in second set of features.
xi. If Euclidian distance >□, shot change is detected.
xii. Otherwise shot change is not detected.

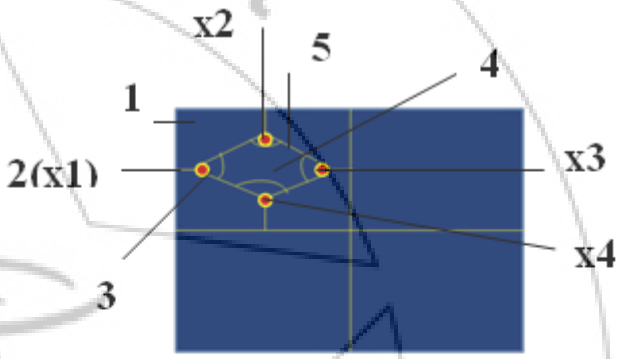

Figure 4: Angle and Area of Polygon

Where,

1 → Area of Image Block

2 → Corner points with minimum distance from all the four sides.

3 → Angle of the polygon (θ)

4 → Area of polygon

5 → Polygon

3. Results

i. All algorithms discussed above are implemented on four different types of videos such as Football.avi, Hurricane.avi, Cut.avi and Movie.avi
ii. But the results are shown for only Hurricane.avi video in Figure 4, 5, 6(□ varies between 1 and 5).

Figure 4: Shots detected for Profiling

Figure 5: Shots detected for Centroid

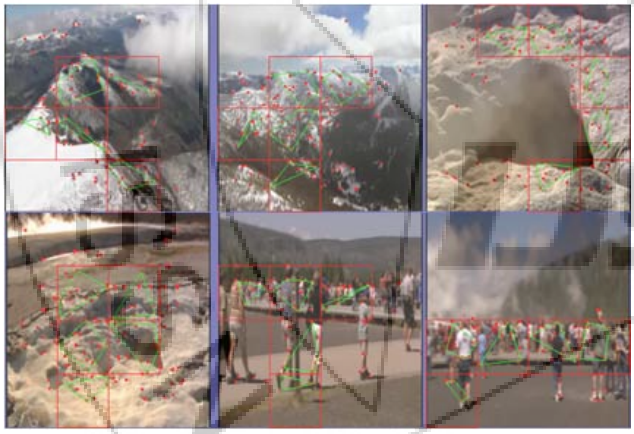

Figure 6: Shots detected for Polygon

3.1 Observation and Analysis

The result obtained for all the three algorithms shown has to be analyzed to measure the performance of all the three algorithms. To measure this performance, accuracy has to be calculated. Accuracy is measured with the help of Precision and Recall which is done for four different types of videos such as Football.avi, Hurricane.avi, Cut.avi and Park.avi.

- Recall: (Correct)/(Correct + Miss)
- Precision: (Correct)/(Correct + False)

Table 1

Input Video	*No. of Frames*	*Shots detected*	*Precision*	*Recall*
Football.avi	1711	9	75%	100%
Hurricane.avi	1390	5	83%	85%
Movie.avi	617	5	62%	72%
Cut.avi	610	6	85%	89%

Table 2

Input Video	*No. of Frames*	*Shots detected*	*Precision*	*Recall*
Football.avi	1711	9	75%	95%
Hurricane.avi	1390	5	71%	91%
Movie.avi	617	5	83%	82%
Cut.avi	610	6	75%	100%

Table 3

Input Video	*No. of Frames*	*Shots detected*	*Precision*	*Recall*
Football.avi	1711	9	81%	90%
Hurricane.avi	1390	5	62.5%	85%
Movie.avi	617	5	55%	79%
Cut.avi	610	6	60%	80%

Form the above observation we can analyze that Centroid method performs better than the rest of two methods and also among the two corner detectors, Harris works best.

4. Conclusion

Visual Bag of Words has provided an overview of a model which was first proposed for text retrieval system and then due to further enhancements it is applicable in many other applications such as Video Shot Detection, Robotic applications, etc. So, it is also proved that Visual bag of Words has performed well in the respective fields specified above.Thus we adopted this popular approach for object class detection. To the authors' best knowledge, our work is the first which uses BoVW approach which will classify the shots based on the features extracted from each frame. We utilized the efficient implementations in our method. In future work, we will investigate other video processing tasks using BoVW approach and optimization of our implementation to run with low computation time.

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