Effect of Changing Distances for Extracting Image Information for Error Reduction of Mouth Features

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Verity of information of the image in the form of image features is used in different application like pattern recognition, feature matching, image segmentation, image fusion, video processing, visual surveillance, medical diagnosis, traffic safety monitoring, remote sensing, human computer interaction, etc. Image is defined precisely and uniquely with the help of features which are useful in classifying and recognition of images. Extracting information from features of the image is a complex and diverse phenomenon. Retrieval of correct image information becomes very difficult for error reduction in the image processing. Lighting effect, zoom, distance, position, color model selected, angle of the object from camera etc. are considerable factors that affects the accuracy of feature detection from the image. In this paper we studied and experimentation using Viola Jones algorithm are performed on distance and zoom for object detection for mouth feature detection on primary face database which is captured by smartphone. Analysis of the result concludes that as distance between object and camera increases, false negatives (Type II error) increase in mouth feature detection and it goes increasingly if the camera goes far away from object. These false negatives can be reduced by increasing zoom of the camera to achieve the accuracy and improve the mouth feature detection.

Keywords: Feature Extraction, Image texture, Human semantics, Type II error, Feature Detection.

1. INTRODUCTION

As images are diverse in texture, color, intensity, objects, brightness, size and shape etc. it becomes difficult to extract correct and accurate information from images (Yang, Kriegman, and Ahuja, 2002).

Image information can be retrieved by text or contents of an image (Sirsat and Chavan, 2016). Text-based information retrieval may be structured or semi-structured (Sirsat, CHAVAN, and DESHPANDE, 2014) which has its own limitations such as lack of formatted document structure, limited to a particular language as well as the document may not discriminate between the text and schema (Guezouli and Essafi, 2016). Therefore content-based information retrieval is mostly used to minimize the errors and increase the accuracy of information to be retrieved from the image. To effectively characterize features of images and minimize the errors in information retrieval, content-based image retrieval techniques are used which is based on image descriptors or features of images (Kumar and Sreekumar, 2014). Human face features can be executed using Viola Jones algorithm.

2. FEATURE EXTRACTION

Feature is the most significant aspect with respect to processing image which describe the behavior of an image and contain information which is a distinguishing characteristic of an image

(Kumar and Bhatia, 2014). Therefore, the extracting feature mostly used to obtain the significant information from novel source of data irrespective of size, position and situation (Kaur and Sharma, 2017) and characterize this information in form of a lower dimensionality space (Rajan and Mathew, 2019). While extracting correct feature from image, there is a gap between features of images and richness of human semantics (Samangooei, Guo, and Nixon, 2008). The variance between the low level features extraction from images and user's need of the high level information is known as, semantic gap (Reid and Nixon, 2010).

Therefore, to reduce the semantic gap and accuracy in visual interpretation of image, is the main task in feature detection. Feature extraction technique used to extract certain features such as edges, corners (Sumithra and Devika, 2012) which helpful to extract eye, nose, mouth from face images (Rajan and Mathew, 2019) (Khan, Abdullah, and Zainal, 2013). Among all available techniques of feature detection, Viola Jones gives better result with higher accuracy in upper body detection from still image (El Maghraby, Abdalla, Enany, and El, 2014) (Dabhi and Pancholi, 2016).This algorithm uses Haar-like features to capture human-face features because these features have some sort of resemblance to the facial features to the characteristics of faces (?, ?) (Deshpande and Ravishankar, 2017). Haar-like features are categorized into bi-adjacency matrices for the feature, tri- adjacency matrices for the feature and quadra-adjacency matrices (Huang, Shang, and Chen, 2019), where tri-adjacency matrices are used for nose and mouth detection from face image (Hussein and Mutlag, 2019) (Nagarajan and Balasubramanie, 2007).

3. PROPOSED RESEARCH WORK

Zoom are checked by increasing distance and effect on mouth feature detection from face images using Viola Jones algorithm are observed on 26 images which is captured by smartphone Oppo A52020 model as shown in fig. 1. These images are captured from different distances i.e. 3ft, 5ft, 8ft, 11ft, 13 ft and 15 ft. With every distance we have captured 3 images per person (object) with 1x zoom, 2x zoom and 3x zoom. Thus, captured 6*3 =18 images per object and observed the accuracy of mouth feature detection on it.

The experiment is focused on the increased zoom and distance effect on mouth detection using Viola Jones algorithm. Result shows that upto 8ft distance mouth is detected but in case of 11ft, 13ft and 15ft some false detection of mouth is observed. But zoom increases for 11ft, 13ft and 15ft false detection also decreased. Fig. 2.1, 2.2 and 2.3 shows false mouth detection from 11ft, 13ft and 15ft decreases as increased the zoom from 1x to 3x.

4. RESULTS & DISCUSSION

Table 1 shows result of mouth feature detection with various zoom effect from different distances i.e. 3ft, 5ft, 8ft, 11ft, 13ft and 15 ft with 1x, 2x and 3x zoom effect on 26 images (objects). In this, M represents 100 % mouth detection, N represents no mouth detection, M-with any numeric value represents multiple number of detections which are false detections, M_Count represents total number of accurate mouth detection and N_Count represents total number of false detection of mouth feature in the given database. This result represented in the form of numeric values in table 2.

Table 3, shows the summary of M_Count and N_Count for mouth feature detection from different zoom and distances. In this table 3, M_Count represents total number of accurate mouth detection i.e. True Positive (TP) and N_Count shows total number of false mouth detection i.e. False Negative (FN) .

From the experiment, it is observed that as zoom increases from 1x to 3x, the M_Count i.e. (True Positive) decreased and N_Count (i.e. False Negative) also decreased.

Table 3 shows, false negatives (FN) not observed upto 8ft distances. False negatives observed

Table I: Table 1 - Result of mouth feature detection with various zoom effect for different distances

Mouth Detection																		
	3 ft	**5 ft**	**8 ft**	**11 ft**	**13 ft**	**15 ft**												
	1x	**2x**	**3x**	**1x**	**2x**	**3x**	**1x**	**2x**	**3x**	**1x**	**2x**	**3x**	**1x**	**2x**	**3x**	**1x**	**2x**	**3x**
Object 1	M-5	M-6	M-4	M-4	M-9	M-6	M-2	M-7	M-5	M-2	M-5	M-7	M-2	M-5	M-8	N	M-4	M-4
Object 2	M-5	M-4	M-4	M-4	M-3	M-4	M	M-11	M-5	M	M-2	M	M	M-3	M-3	M	M	M-5
Object 3	M-11	M-11	M-3	M-14	M-15	M-11	M	M-8	M-10	M-2	M-3	M-3	M-2	M-3	M	M	M-2	M-5
Object 4	M	M-5	M	M-3	M-12	M-10	M-5	N	N-10	M-3	M-3	M-5	M-2	M-3	M-5	M	M	M-9
Object 5	M-4	M-5	M-4	M-3	M-6	M-3	M-2	M-8	M-4	M-3	M-2	M-2	M-3	M-3	M	M	M-5	M-4
Object 6	M-2	M-3	M-2	M	M-3	M-4	M-2	M	M	M- 12	M-5	M-4	M-2	M-7	M-4	M-3	M-2	M-2
Object 7	M-4	M-15	M-2	M-2	M-5	M-2	M-2	M-2	M-3	N-2	M-2	M-2	N	M-2	M	N	M-4	M-2
Object 8	M-3	M-4	M-3	M-2	M-4	M-3	M-4	M	M-3	M-3	M-3	M-2	M	M-2	M	N-1	M	N
Object 9	M	M-4	M-4	M-2	M-4	M-6	M-2	M-5	M-4	N-3	M-6	M-5	N-2	M-6	M-4	N	M-2	M-5
Object 10	M-2	M-3	M-4	M	M-3	M-5	M	M-3	M-3	M	M-2	M-2	N	M	M-2	M	M	M
Object 11	M-2	M-2	M-4	M	M-2	M-3	M	M-2	M	M-2	M-4	M-4	M-2	M-5	M-3	M	M-3	M-5
Object 12	M-4	M-3	M-4	M-6	M-2	M-2	M	M-5	M-2	M-3	M-4	M-2	N-1	M-5	M-3	N-1	M-4	M-2
Object 13	M-5	M-4	M-4	M-6	M-4	M-3	M-6	M-6	M-3	M-6	M-6	Y-8	M-5	M-8	M-7	M	M-6	M-7
Object 14	M-4	M-5	M-2	M-2	M-3	M-3	M	M-2	M-3	M-2	M-2	M-2	M-3	M-2	M-2	N-1	M-2	M-3
Object 15	M-3	M-3	M-2	M-3	M-3	M-2	M	M	M	N	N	N	N-3	M-4	M-2	N-2	M	M
Object 16	M-2	M-3	M	M	M	M-3	M	M-2	M	M-2	M-5	M-3	M-2	M-2	M	M-2	M	M
Object 17	M-2	M-2	M-2	M-4	M-3	M-2	M-2	M-2	M-2	M-2	M-2	N	N-1	N-1	N-1	N	M-2	M-6
Object 18	M-5	M-4	M-2	M-3	M-4	M-2	M	M-8	M-11	M-4	M-5	M-6	M-3	M-5	M-3	M	M-3	M-2
Object 19	M-2	M-3	M	M	M-3	M-2	M-2	M-3	M-3	M-2	N	M-2	M	N	M-2	M-3	M-3	M-3
Object 20	M	M-7	M-5	M-2	M-3	M-3	M-3	M-5	M-3	M-3	M-2	M-2	M	M-4	M-2	M	M-2	M-2
Object 21	M-3	M-4	M-4	M-5	M-2	M-2	M-4	M-2	M	M-4	M-8	M	M-3	M-5	M-6	M-3	M-5	M-4
Object 22	M-3	M-3	M-2	M-6	Y-4	M-2	M-4	M-3	M-2	M-2	M-2	M-2	M	M	M	M-2	M-5	M-3
Object 23	M-4	M-6	M-3	M-3	Y-16	M-7	M-6	M-6	M-11	M	M-12	M-7	M	M-6	M-5	M	M-2	M-4
Object 24	M-8	M-5	M-3	M-12	M-7	M-4	M-4	M-6	M-6	M-2	M-11	M-6	M-2	M-5	M-2	M	M-5	M-5
Object 25	M	M-3	M-3	M-2	M-3	M-2	M-2	M-8	M-4	M-5	M-3	M-6	M-3	M-2	M-2	M-3	M-6	Y-8
Object 26	M-11	M-8	M-6	M-2	M-2	M-2	M	M	M	M-2	M-2	M	M-2	M-4	M-2	M-4	M	M-3
Runtime in sec.	183.72	177.11	180.81	168.55	175.05	183.67	180.23	163.81	172.72	197.78	177.14	193.94	213.36	187.16	189.33	206.43	209.48	215.39
M_COUNT	4	0	4	5	1	0	10	4	6	3	0	3	6	2	6	11	7	3
N_COUNT	0	0	0	0	0	0	0	1	0	1	2	2	2	1	0	4	0	1
M%	15.38	0	15.38	19.23	3.84	0	38.46	15.38	23.07	11.53	0	11.53	23.07	7.69	23.07	42.30	26.92	11.53
N%	0	0	0	0	0	0	0	3.84	0	3.84	7.69	7.69	7.69	3.84	0	15.38	0	3.84

Table II: Table 2 - Result of mouth feature detection with various zoom effect for different distances in numerical representation

Mouth Detection																		
	3 feet's	5 feet's	8 feet's	11 feet's	13 feet's	15 feet's												
	1-X	**2-X**	**3-X**	**1-X**	**2-X**	**3-X**	**1-X**	**2-X**	**3-X**	**1-X**	**2-X**	**3-X**	**1-X**	**2-X**	**3-X**	**1-X**	**2-X**	**3-X**
Object 1	20	16.66	25	25	11.11	16.66	50	14.28	20	50	20	14.28	50	20	12.5	0	25	25
Object 2	20	25	25	25	33.33	25	100	9.09	20	100	50	100	100	33.33	33.33	100	100	20
Object 3	9.09	9.09	33.33	7.14	6.66	9.09	100	12.5	10	50	33.33	33.33	50	33.33	100	100	50	20
Object 4	100	20	100	33.33	8.33	10	20	0	0	33.33	33.33	20	50	33.33	20	100	100	11.11
Object 5	25	20	25	33.33	16.66	33.33	50	12.5	25	33.33	50	50	33.33	33.33	100	100	20	25
Object 6	50	33.33	50	100	33.33	25	50	100	100	8.33	20	25	50	14.28	25	33.33	25	50
Object 7	25	6.66	50	50	20	50	50	50	33.33	0	50	50	0	50	100	0	25	50
Object 8	33.33	25	33.33	50	25	33.33	25	100	33.33	33.33	33.33	50	100	50	100	0	100	0
Object 9	100	25	25	50	25	16.66	50	20	25	0	16.66	20	0	16.66	25	0	50	20
Object 10	50	33.33	25	100	33.33	20	100	33.33	33.33	100	50	50	0	100	50	100	100	100
Object 11	50	50	25	100	50	33.33	100	50	100	50	25	25	50	20	33.33	100	33.33	20
Object 12	25	33.33	25	16.66	50	50	100	20	50	33.33	25	50	0	20	33.33	0	25	50
Object 13	20	25	25	16.66	25	33.33	16.66	16.66	33.33	16.66	16.66	12.5	20	12.5	14.28	100	16.66	14.28
Object 14	25	20	50	50	33.33	33.33	100	50	33.33	50	50	50	33.33	50	50	0	50	33.33
Object 15	33.33	33.33	50	33.33	33.33	50	100	100	100	0	0	0	0	25	50	0	100	100
Object 16	50	33.33	100	100	100	33.33	100	50	100	50	20	33.33	50	50	100	50	100	100
Object 17	50	50	50	25	33.33	50	50	50	50	50	50	0	0	0	0	0	50	16.66
Object 18	20	25	50	33.33	25	50	100	12.5	9.09	25	20	16.66	33.33	20	33.33	100	33.33	50
Object 19	50	3	100	100	33.33	50	50	33.33	33.33	50	0	50	100	0	50	33.33	33.33	33.33
Object 20	100	14.28	20	50	33.33	33.33	33.33	20	33.33	33.33	50	50	100	25	50	100	50	50
Object 21	33.33	50	100	20	50	50	25	50	100	25	12.5	100	33.33	20	16.66	33.33	20	25
Object 22	33.33	33.33	50	16.66	25	50	25	33.33	50	50	50	50	100	100	100	50	20	33.33
Object 23	25	16.66	33.33	33.33	1006	14.28	16.66	16.66	9.09	100	8.33	14.28	100	16.66	20	100	50	25
Object 24	12.5	20	33.33	8.33	14.28	25	25	16.66	16.66	50	9.09	16.66	50	20	50	100	20	20
Object 25	100	33.33	33.33	50	33.33	50	50	12.5	25	20	33.33	16.66	33.33	50	50	33.33	16.66	12.5
Object 26	9.09	12.5	16.66	50	50	50	100	100	100	50	50	100	50	25	50	25	100	33.33
Runtime in sec.	183.72	177.11	180.81	168.55	175.05	183.67	180.23	163.81	172.72	197.78	177.14	193.94	213.36	187.16	189.33	206.43	209.48	215.39
M_COUNT	4	0	4	5	1	0	10	4	6	3	0	3	6	2	6	11	7	3
N_COUNT	0	0	0	0	0	0	0	1	1	3	2	2	6	2	1	8	0	1
M%	15.38	0	15.38	19.23	3.84	0	38.46	15.38	23.07	11.53	0	11.53	23.07	7.69	23.07	42.30	26.92308	11.53
N %	0	0	0	0	0	0	0	3.84	3.84	11.53	7.69	7.69	23.07	7.69	3.84	30.76	0	3.84

Fig 1 - Face image database used for mouth feature detection

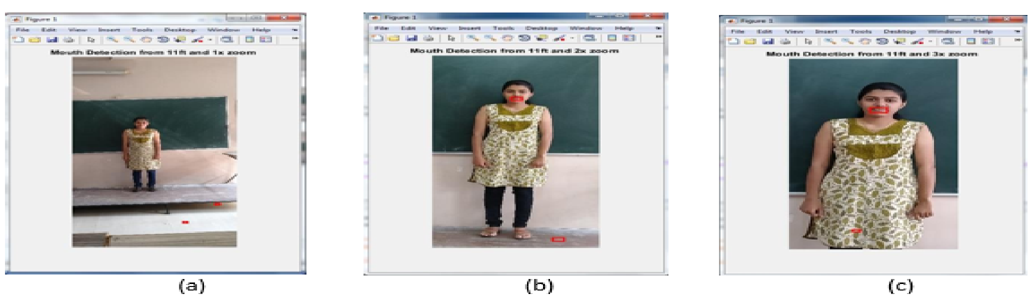

Fig. 2.1- False negative decreases as zoom increases for mouth detection for 11 ft distance with 1x, 2x and 3x zoom

Table III: Table 3 - Summary of M_Count and N_Count for mouth detection for different zoom and distances

	1x zoom	2x zoom	3x zoom			
	M_Count.	N_Count.	M_Count.	N_Count.	M_Count.	N_Count.
3 ft	4	0	0	0	4	0
5 ft	5	0	2	0	0	0
8 ft	10	0	4	1	6	1
11 ft	3	3	0	2	3	2
13 ft	6	6	2	2	6	1
15 ft	11	8	7	0	3	1

at 11ft, 13ft and 15 ft only. It is also observed that, FN decreases as the zoom increases and it represented in fig. 3.

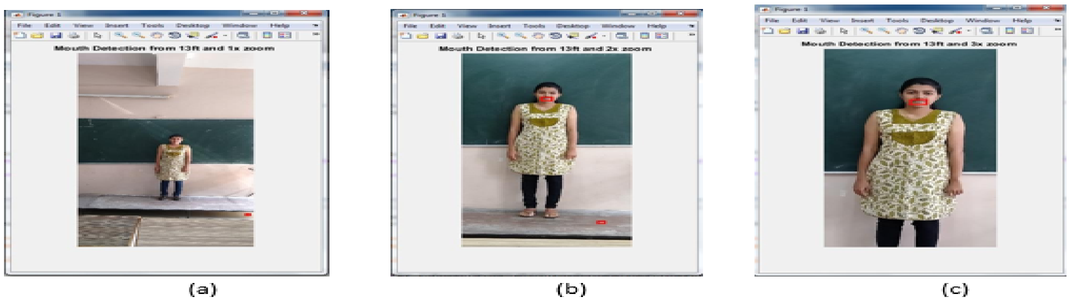

Fig.2.2 - False negative decreases as zoom increases for mouth detection for 13ft distance with 1x, 2x and 3x zoom

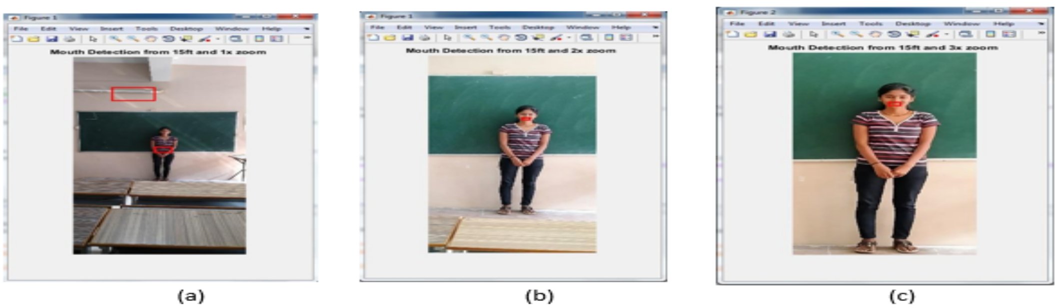

Fig. 2.3 - False negative decreases as zoom increases for mouth detection for 15 ft distance with 1x, 2x and 3x zoom

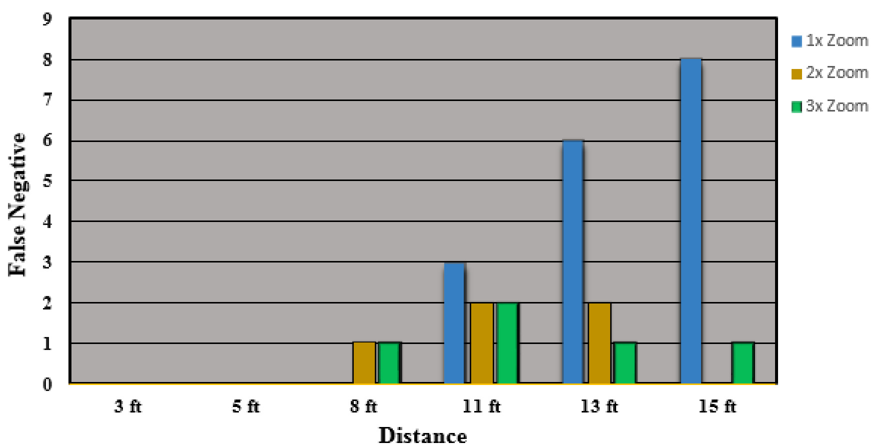

Fig. 3 - False Negative (FN) or Type II error decreases with increased zoom from different distances

False negative (FN) also known as Type II error which can be reduced with increased zoom images and we can get accurate mouth feature detection.

Therefore, accurate detection of mouth i.e. True Positive Rate (or sensitivity) can be calculated with the formula [17] -

True Positive Rate (TPR) from 3ft, 5ft, 8ft, 11ft, 13ft and 15ft from 1x, 2x and 3x zoom is represented in table 4.

It is observed that as the zoom increases the TPR is decreased from different distances and it

$$True\ Positive\ Rate\ (TPR) = \frac{Number\ of\ True\ Positve(Tp)}{Total\ number\ of\ Positive\ in\ data\ set\ (nP)}$$

Table IV: Table 4 - True positive rate (TPR) from different distances with different zoom

	1x	2x	3x
3 ft	0.15	0	0.15
5 ft	0.19	0.038	0
8 ft	0.38	0.15	0.23
11 ft	0.11	0	0.11
13 ft	0.23	0.038	0.19
15 ft	0.57	0.26	0.11

is represented in graphical format in fig. 4

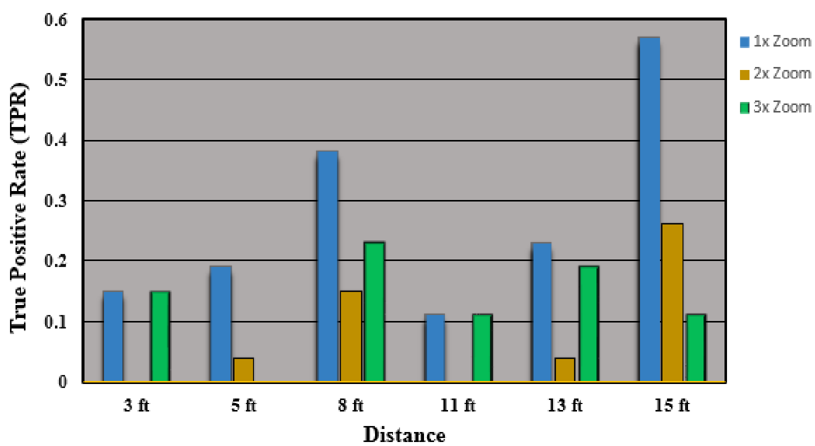

Fig. 4 - Ture Positive Rate (TPR) representation with increased zoom from different distances

5. FINDINGS

The experiment is performed on 26 basic images which are captured from smartphone camera from different distance of 3ft, 5ft, 8ft, 11ft, 13ft and 15ft with 1x, 2x and 3x zoom to check the effect of increased zoom and distance on mouth feature detection using Viola Jones algorithm by extracting information on mouth feature for face detection of the object. It has been observed from analysis of True Positive (TP) observation, False Negative (FN) observation and True Positive Rate (TPR) observations from the experiment:

(1) Maximum false negatives are observed at 3ft, 5ft and 8ft i.e. 0%, 0% and 3.84% respectively keeping zoom at 3x. False negative keeping zoom constant are increases as distance increases from 3 ft to 8ft shows that higher accuracy of mouth feature detection.

(2) False negatives values at 11ft, 13ft and 15ft distances are comparatively more than upto 8ft distance i.e. 7.69% , 11.53 % and 11.53% respectively for detecting mouth features of the object which captured by the smartphone camera. This shows that the detecting the mouth features of the objects using Viola Jones algorithm is decreases keeping zoom constant.

(3) For the false negative for 1X zoom at distance of 3ft, 5ft, 8ft, 11ft,13ft, and 15ft distance values of false negative are 0%, 0%, 0%, 11.53% 23.07%, and 30.76 % respectively. From this

it is conclude that up to 8ft of distance mouth feature detecting accuracy is same; but it decreases with increase in distance. At 15ft of distance as the zoom increases from 1x to 3x, false negatives reduced from 8 to 1 i.e. value reduced from 30.76 % to 3.84 % means mouth feature detection decreases.

6. CONCLUSION

It is concluded that as zoom increases from different distances, true positives is increases and false negatives decreases this results in higher accuracy of mouth feature detection. It can conclude that zoom has direct effect on detecting mouth features of the object image keeping distance constant. On the basis of results observed it is concluded that as distance between object and camera increases, false negatives (Type II error) are going to be increases after 8ft distance in mouth feature detection using Viola Jones algorithm and it goes increasingly if the camera goes far away from object. Increase in false negatives is reduced by increasing zoom of the camera to achieve more accuracy and improve the mouth feature detection. Thus mouth feature detection is improved by reducing type II error upto 3.84% on increased distance images by increasing zoom of the camera.

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