International Journal of Computer Applications (0975 – 8887)
Volume 148 – No.9, August 2016

Gaussian Fitting Model for Non-Geometric Features in Gesture Recognition System: Analysis Study

Mokhtar M. Hasan
College of Science for Women,
University of Baghdad,
Baghdad, Iraq

ABSTRACT
Gesture language is considered as secondary language for most of people and main language for hearing impaired people, it is considered as international non-spoken language that make the understanding between different tongues possible regardless which country is this, it is also considered the first language that can be act for children in which they express they need in a movement.

There are vast range of non-geometric features that can applied to recognize specific object, we have applied in this paper novel algorithm by building Gaussian model that covers the area of the hand gesture which may or may not circular area, because of that Gaussian is chosen for any circular or oval shape depending on the presented gesture itself, furthermore, rotation variation has been solved in order to reduce the database size used for training the model, experimental results show a promising outcomes that dominant on the other non-geometric techniques.

General Terms
Non geometric features, gesture recognition system

Keywords
Gesture recognition system, Gaussian classifier, Gaussian model, non-geometric features

1. INTRODUCTION
Gesture recognition system may suffer from verity of problems, scaling, translation, illumination and rotation perturbations [1], illumination challenge can be solved by normalizing the color model such as using normalized rgb instead of RGB itself [2], this will help removing any illumination in the input scene and focusing on the important information found in the input gesture, scaling and translation can be overcome by setting the image into a fixed size after trimming operation takes place.

However, rotation perturbation is considered as the most sophisticated problem and usually ignored by many researchers or providing many patterns for each single rotated gesture which increases the dataset volume used for training purposes [3], for example, 2280 different patterns to detect the rising finger in [4], furthermore, 6, 40, 124, and 20 patterns for each single posture in [5], [6], [7], and [8] respectively; but, however, some researchers kept this number low and of course, their method will suffer from rotation variance, this can be found in [9][10][11] and [12].

The solution is to unify the direction of all presented objects [3] and in this case all gestures are having the same direction which reduces the need for the multiple-gesture for each gesture rotation.

Special consideration is needed for sign language since shape and motion are needed [11]; and the important and imperative operation is the motion modeling [11] and the tracking will interfere with such term.

Gesture has many application such as controlling house appliances [13], robot control [13], and augmented reality as well [14].

Helicopter signaler, traffic police, and all careers that are considered to be gesture oriented professional [15].

We have presented the analysis of our work in [16] in order to demonstrate the originality and the impact of Gaussian Multivariate for Non-Geometric Features Fitting.

2. OBJECT FILLING
In this step, the object -that is gesture in this case- should be fitted completely with a Gaussian Multivariate model with some parameters that calculated from the input gesture itself to success the fitting.

Hand center is calculated , direction is calculated as well using the algorithm in [3], borders of the hand is located as seen figure 1.

As seen, the blue circle represents the old calculated center while the red middle circle represents the new calculated center by averaging all of four border yellow points.

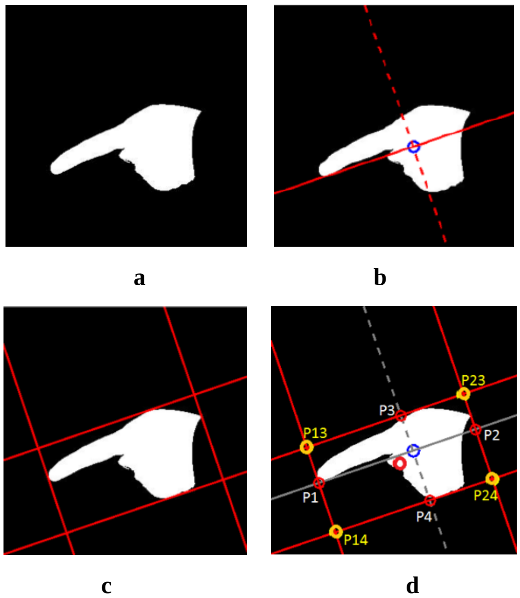


Fig 1: Locating the hand gesture, a: input gesture, b: hand center and direction, c: locating hand boundaries, c: extracting boundary points.

However, the extracted parameters of figure 1 can be expressed as follows and can be used to build Gaussian Bivariate Model.

$$Center(\mu_x,\mu_y)=(P13(x,y)+P23(x,y)+P14(x,y)+P24(x,y))/4 \quad (1)$$

$$FPD=\sqrt{(P1.x-P2.x)^2+(P1.y-P2.y)^2} \quad (2)$$

$$SPD=\sqrt{(P3.x-P4.x)^2+(P3.y-P4.y)^2} \quad (3)$$

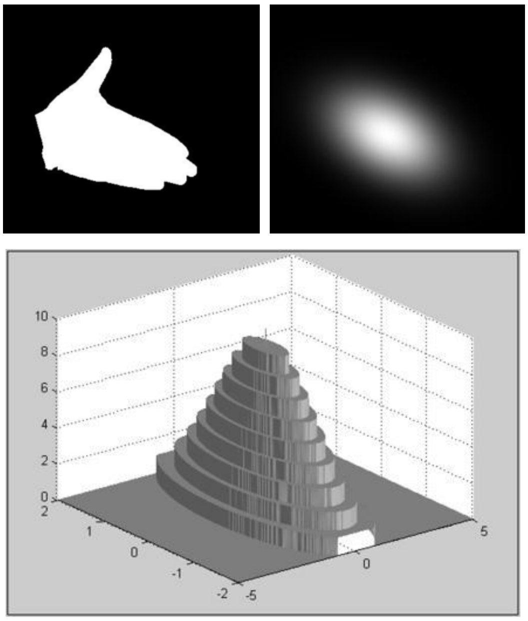
Table 1: Necessary parameters for Gaussian bivariate distribution for Figure 1

FPD	SPD	$\sum_{xx}$	$\sum_{yy}$	$\sum_{xy}$	μ_x	μ_y
226	122	2447.7	833.7	-181.5	175	215

3. BUILDING GAUSSIAN BiVARIATE MODEL

After extracting the parameters as seen in table 1, those parameters are used to build the Gaussian Bivariate Model.

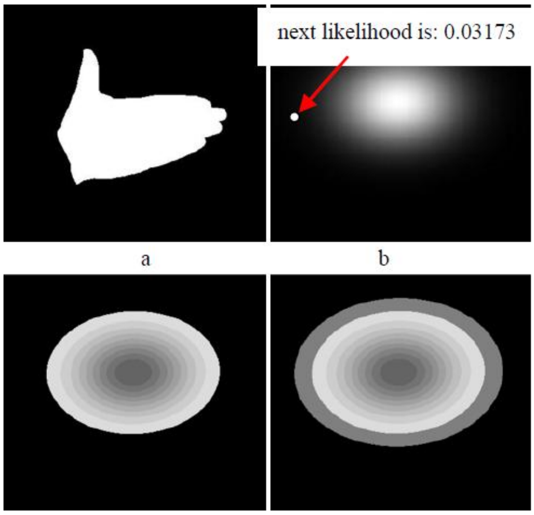
Figure 2 shows an example of the Gaussian model that build for the presented input gesture after extracting the necessary parameters as in Table 1.



a b c

Fig 2: Gaussian Model, a: input gesture, b: 2D Gaussian model, c: 3D Gaussian model.

So, in order to unveil the 3D Gaussian in a 2D image, the following Figure shows this fact [16].



c d

Fig 3: Gaussian model, a: input gesture, b: Gaussian model, c: real shape of Gaussian, d: after adding extra terrace to best fit of the input gesture.

Each single circle is called terrace as in figure 3, this circle is divided into 8 portions and the geometric central moment of that portion represent the feature of it, so, every single circle can produce 8 features and there are 11 terraces in each Gaussian, so, 11*8=88 features, as in equation 4.

$$\mu_{pp}=\sum_x \sum_y (x-\mu_x)^p (y-\mu_y)^p f(x,y) \quad (4)$$

So that p=0 and p=1 only, moreover, two more features are calculated according to equation 5 and considered as global features, total features are: 88 * 2 (μ_{00} and μ_{11})+2 global features= 178, these features represents the training features and can be used with any recognition tool.

4. EXPERIMENTAL RESULTS

The main objective is to reduce the database used for training which achieved in here, by providing only one gestures for training, we have obtained recognition percentage of 90% regardless the testing gestures used which considered in hundreds, training samples raised to 5; the recognition percentage reached the maximum possible value which is 100%, figure 4 shows this fact.

Fig 4. Recognition percentages achieved.

5. CONCLUSION

We have seen a novel algorithm for fitting of hand gesture with a Bivariate Gaussian Model after finding the direction of the hand gesture, the reason is to reduce the database size used for training as well as solving of the rotation perturbation, and both aims were achieved with higher recognition percentages, starting from one training gesture, the recognition percentage was 90%, beyond 4 gestures for training, the recognition percentages is 100%.

6. ACKNOWLEDGMENTS

Our thanks to the experts who have contributed towards development of the template

7. REFERENCES

[1] Mokhtar M. Hasan, Noor Adnan Ibraheem, “Mixture of GMMs and Mixture of Multiple Histograms for Image Segmentation: A Review”, International Journal of Computer Science, vol. 4 , issue 2, number 2, pp.739-743, July 2016.

[2] Noor A. Ibraheem, Rafiqul Z. Khan, Mokhtar M. Hasan, “Comparative Study of Skin Color Based Segmentation Techniques”, International Journal of Applied Information Systems (IJAIS), vol. 5 (10): 24-39, USA, August 2013.

[3] Hasan, M.M., Mishra, P.K., “Direction Analysis Algorithm using Statistical Approaches”, SPIE 4th International Conference on Digital Image Processing, 8334-28, 83340L (2012), Malaysia, April 2012, doi: 10.1117/12.946046.

[4] J. Mackie ,B. McCane, “Finger Detection with Decision Trees”, University of Otago, Department of Computer Science.

[5] Jochen Triesch, and Christoph von der Malsburg, “A system for person-independent hand posture recognition against complex backgrounds”, IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 23 (12), pp. 1449-1453, Dec 2011, doi: 10.1109/34.977568.

[6] Xingyan Li, “Vision Based Gesture Recognition System with High Accuracy”, Department of Computer Science, The University of Tennessee, Knoxville, 2005.

[7] Agnes Just, Yann Rodriguez, Sebastien Marcel, “Hand Posture Classification and Recognition using the Modified Census Transform”, In Proceedings of the IEEE International Conference on Automatic Face and Gesture Recognition (AFGR 2006), Southampton , UK, April 2006, doi: 10.1109/FGR.2006.62.

[8] Simei G. Wysoski, Marcus V. Lamar, Susumu Kuroyanagi , Akira Iwata , “A Rotation Invariant Approach On Static-Gesture Recognition Using Boundary Histograms And Neural Networks”, In Proceedings of the 9th IEEE International Conference on Neural Information Processing (ICONIP '02), Vol. 4, pp. 2137 – 2141, Singapore, Nov, 2002, doi: 10.1109/ICONIP.2002.1199054.

[9] Ravikiran J, Kavi Mahesh, Suhas Mahishi, Dheeraj R, Sudheender S, and Nitin V Pujari,” Finger Detection for Sign Language Recognition”, Proceedings of the International MultiConference of Engineers and Computer Scientists (IMECS 2009), vol. I, Hong Kong, March 2009.

[10] Jagdish Lal Raheja, Karen Das, and Ankit Chaudhary, “An Efficient Real Time Method of Fingertip Detection”, 7th International Conference on Trends in Industrial Measurements and Automation (TIMA 2011), Chennai, India, Jan 2011, pp. 447-450.

[11] Sung Kwan Kang, Mi Young Nam ,and Phill Kyu Rhee, “Color Based Hand and Finger Detection Technology for User Interaction”, IEEE International Conference on Convergence and Hybrid Information Technology, 2008, pp. 229-236, doi: 10.1109/ICHIT.2008.292.

[12] Noor Shaker, M. Abou Zliekha, “Real-time Finger Tracking for Interaction”, IEEE 5th International Symposium on Image and Signal Processing and Analysis (ISPA 2007), Istanbul, 2007, pp. 141-145, doi: 10.1109/ISPA.2007.4383679.

[13] Noor A. Ibraheem, Mokhtar M. Hasan, Rafiqul Z. Khan, “An Investigation on Gesture Analysis and Geometric Features Extraction”, International Journal of Innovative Research in Computer and Communication Engineering, vol. 3 (1): 387-392, India, January 2015, doi: 10.15680/ijircce.2015.0301037.

[14] Mokhtar M. Hasan, Pramod K. Mishra, “Real Time Fingers and Palm Locating using Dynamic Circle Templates”, International Journal of Computer Applications, vol. 41 (6): 33-43, USA, March 2012, doi: 10.5120/5547-7615.

[15] Mokhtar M Hasan, “New Rotation Invariance Features Based on Circle Partitioning”, Journal of Computer Engineering & Information Technology, vol. 2 (2), USA, July 2013, doi: 10.4172/2324-9307.1000108.

[16] Mokhtar M. Hasan, Pramod K. Mishra, “Features Fitting using Multivariate Gaussian Distribution for Hand Gesture Recognition”, International Journal of Computer Science and Emerging Technologies, vol. 3(2):73-80, UK, April 2012.