**References:**

1] WHO calls on private sector to provide affordable hearing aids in developing world. [Internet]. Current neurology and neuroscience reports. U.S. National Library of Medicine; 2001 [cited 2019Jan22]. Available from: https://www.ncbi.nlm.nih.gov/pubmed/11887302

[2] Das K, Singha J. Hand Gesture Recognition Based on Karhunen-Loeve Transform. 2013Jan17;:365–71.

[3] Aryanie D, Heryadi Y. American sign language-based finger-spelling recognition using k-Nearest Neighbors classifier. 2015 3rd International Conference on Information and Communication Technology (ICoICT). 2015;

[4] Sharma R. Recognition of Single Handed Sign Language Gestures using Contour Tracing descriptor. Proceedings of the World Congress on Engineering 2013 Vol II ,WCE 2013. 2013Jul3;.

[5] Starner T, Pentland A. Real-time American Sign Language recognition from video using hidden Markov models. Proceedings of International Symposium on Computer Vision - ISCV. :227–43.

[6] Jebali M, Dalle P, Jemni M. Extension of Hidden Markov Model for Recognizing Large Vocabulary of Sign Language. International Journal of Artificial Intelligence & Applications. 2013;4(2):35–44.

[7] Suk H-I, Sin B-K, Lee S-W. Hand gesture recognition based on dynamic Bayesian network framework. Pattern Recognition. 2010;43(9):3059–72.

[8] Mekala P, Gao Y, Fan J, Davari A. Real-time sign language recognition based on neural network architecture. 2011 IEEE 43rd Southeastern Symposium on System Theory. 2011;:14–6.

[9] Admasu YF, Raimond K. Ethiopian sign language recognition using Artificial Neural Network. 2010 10th International Conference on Intelligent Systems Design and Applications. 2010;:995–1000.

[10] Atwood J, Eicholtz M, Farrell J. American Sign Language Recognition System. Artificial Intelligence and Machine Learning for Engineering Design. Dept of Mechanical Engineering. 2012;.

[11] Pigou P. Sign Language Recognition Using Convolutional Neural Networks. European Conference on Computer Vision. 2014Sep6;

12] Mitchell, Ross, Young, Travas, Bachleda, Bellamie, et al. "How Many People Use ASL in the United States?: Why Estimates Need Updating" (PDF). Vol. 6. Gallaudet University Press; 2012.

13] William Vicars / ASL University. ASL [Internet]. Children of Deaf Adults (CODA). [cited 2019Jan29]. Available from: http://www.lifeprint.com/.

14] Home Page [Internet]. Province of Manitoba. Government of Manitoba, Water Stewardship Division, Ecological Services Division, Planning and Coordination Branch; [cited 2019Jan29]. Available from: <http://www.manitoba.ca/index.html>

15 ] Mitra S, Acharya T. Gesture Recognition: A Survey. IEEE Transactions on Systems, Man and Cybernetics, Part C (Applications and Reviews). 2007;37(3):311–24.

16] Nagi J, Ducatelle F, Caro GAD, Ciresan D, Meier U, Giusti A, et al. Max-pooling convolutional neural networks for vision-based hand gesture recognition. 2011 IEEE International Conference on Signal and Image Processing Applications (ICSIPA). 2011;

17] Bedregal B, Dimuro G, Costa A. Hand Gesture Recognition in an Interval Fuzzy Approach. TEMA - Tendências em Matemática Aplicada e Computacional. 2007;8(1):21–31.

18] Sahoo, Mishra A, S G, Ravulakollu, K K. Sign Language Recognition : State of the Art. Asian Res. State of the Art Asian Res. 9(2):116–34.

19] Phi LT, Nguyen HD, Bui TQ, Vu TT. A glove-based gesture recognition system for Vietnamese sign language. 2015 15th International Conference on Control, Automation and Systems (ICCAS). 2015;:1555–9.

20] Emond A, Ridd M, Sutherland H, Allsop L, Alexander A, Kyle J. The current health of the signing Deaf community in the UK compared with the general population: a cross-sectional study. BMJ Open. 2015;5(1).

21] Bretzner L, Laptev I, Lindeberg T. Hand gesture recognition using multi-scale colour features, hierarchical models and particle filtering. Proceedings of Fifth IEEE International Conference on Automatic Face Gesture Recognition. 2002;:405–10.

22] Mckenna SJ, Morrison K. A comparison of skin history and trajectory-based representation schemes for the recognition of user-specified gestures. Pattern Recognition. 2004;37(5):999–1009.

23] Imagawa I, Matsuo H, Taniguchi R, Arita D, Lu S, Igi S. Recognition of local features for camera-based sign language recognition system. Proceedings 15th International Conference on Pattern Recognition ICPR-2000. 2000;:849–53.

24] Dardas N, Georganas N. Real-time Hand Gesture Detection and Recognition Using Bag-of-Features and Support Vector Machine Techniques. IEEE Transactions on Instrumentation and Measurement. 2011Nov;60(11):3592–607.

25] Zabulis X, Baltzakis H, Argyros A. Vision-based hand gesture recognition for human- computer interaction. Lawrence Erlbaum Associates, Inc; 2009.

26] Rehg J, Kanade T. DigitEyes: vision-based hand tracking for human-computer interaction. Proceedings of 1994 IEEE Workshop on Motion of Non-rigid and Articulated Objects. :16–24

.

27] Gavrila D, Davis L. 3-D model-based tracking of humans in action: a multi-view approach. Proceedings CVPR IEEE Computer Society Conference on Computer Vision and Pattern Recognition. 1996;:73–80.

28] Utsumi A, Ohya J. Image segmentation for human tracking using sequential-image-based hierarchical adaptation. Proceedings 1998 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (Cat No98CB36231). :911–6.

29] Blake A, North B, Isard M. Learning multi-class dynamics. In Proc Advances in Neural Information Processing Systems (NIPS). 1999;11:389–95.

30] Crowley J, Berard F, Coutaz J. Finger tracking as an input device for augmented reality. In International Workshop on Gesture and Face Recognition. 1995Jun;.

31] Rehg J, Kanade T. Model-based tracking of self-occluding articulated objects. Proceedings of IEEE International Conference on Computer Vision. 1995;:612–7.

32] Davis J. Visual gesture recognition. IEE Proceedings - Vision, Image, and Signal Processing. 1994;141(2):101–6.

33] Chen Q, Georganas ND, Petriu EM. Real-time Vision-based Hand Gesture Recognition Using Haar-like Features. 2007 IEEE Instrumentation & Measurement Technology Conference IMTC 2007. 2007;

34] Viola P, Jones M. Robust real-time face detection. Proceedings Eighth IEEE International Conference on Computer Vision ICCV 2001.

35] Viola P, Jones MJ. Robust Real-Time Face Detection. International Journal of Computer Vision. 2004;57(2):137–54.

36] Wu Y, Lin J, Huang T. Capturing natural hand articulation. Proceedings Eighth IEEE International Conference on Computer Vision ICCV 2001. :426–32.

37] Shimada N, Shirai Y, Kuno Y, Miura J. Hand gesture estimation and model refinement using monocular camera-ambiguity limitation by inequality constraints. Proceedings Third IEEE International Conference on Automatic Face and Gesture Recognition. 1998;:268–73.

38] Wu Y, Huang T. Capturing articulated human hand motion: a divide-and-conquer approach. Proceedings of the Seventh IEEE International Conference on Computer Vision. 1999;:606–11.

39] Aran O, Keskin C, Akarun L. Computer Applications for Disabled People and Sign Language Tutoring. Proceedings of the Fifth GAP Engineering Congress. 2006Apr;:26–8.

40] Tokatlı H, Halıcı Z. 3D Hand Tracking in Video Sequences. MSc Thesis. 2005Sep;

41] He J, Zhang H. A Real Time Face Detection Method in Human-Machine Interaction. 2008 2nd International Conference on Bioinformatics and Biomedical Engineering. 2008;

42] Zhu Q, Wu C-T, Cheng K-T, Wu Y-L. An adaptive skin model and its application to objectionable image filtering. Proceedings of the 12th annual ACM international conference on Multimedia - MULTIMEDIA 04. 2004;

43] Kelly W, Donnellan A, Molloy D. Screening for Objectionable Images: A Review of Skin Detection Techniques. 2008 International Machine Vision and Image Processing Conference. 2008;:151–8.

44] Zarit B, Super B, Quek F. Comparison of five color models in skin pixel classification. Proceedings International Workshop on Recognition, Analysis, and Tracking of Faces and Gestures in Real-Time Systems In Conjunction with ICCV99 (Cat NoPR00378). :58–63.

45] Ford A, Roberts A. Color space conversions. Westminster University,London,UK. 1998Aug11;   
46] Gonzalez R, Woods R, Eddins S. Digital Image Processing Using MATLAB. Englewood Cliffs, NJ. 2004;

47] Hughes JF. Computer graphics: principles and practice. Upper Saddle River, NJ: Addison-Wesley; 2014.

48] Nallaperumal K, Ravi S, Babu K, Selvakumar K, Fred A, Seldev C, et al. Skin detection using color pixel classification with application to face detection: A comparative study. Proc IEEE Int Conf Comput Intell Multimedia Appllication. 3:436–41.

49] Abdulla D, Abdulla S, Manaf R, Jarndal AH. Design and implementation of a sign-to-speech/text system for deaf and dumb people. 2016 5th International Conference on Electronic Devices, Systems and Applications (ICEDSA). 2016;

50] Cutler R, Turk M. View-based interpretation of real-time optical flow for gesture recognition. Proceedings Third IEEE International Conference on Automatic Face and Gesture Recognition.

51]Martin J, Devin V, Crowley J. Active hand tracking. Proceedings Third IEEE International Conference on Automatic Face and Gesture Recognition. 1998;573–8.

52] Greenspan H, Goldberger J, Eshet I. Mixture model for face-color modeling and segmentation. Pattern Recognition Letters. 2001;22(14):1525–36.

53] S.L. Phung, D. Chai, and A. Bouzerdoum, “A Universal and Robust Human Skin Color Model Using Neural Networks,” Proc. INNS-IEEE Int’l Joint Conf. Neural Networks, vol. 4, pp. 2844-2849, July 2001.

54] S.J.Russell and P.Norvig .Artificial Intelligence: A Modern Approach .Pearson Education, 2 edition, 2003.

55] I. Kalová. Předzpracování obrazu. VUT Brno Scriptum, Pocitacove videni, Computer Vision Group, 2015 (accessed May 13, 2017).

56] Over under fitting. Knewton blog developer blog [online]; https: //18784-presscdn-0-49-pagely.netdna-ssl.com/wp-content/uploads/ 2014/09/Gizem1.jpg.png, 2014 (accessed May 13, 2017).

57] I. Goodfellow, Y. Bengio, and A. Courville. Deep Learning. MIT Press.

58] Test vs. training error. Stack Exange [online] https://i.stack.imgur.com/ IpI8U.png, 2015 (accessed May 13, 2017).

59] W. McCulloch and W. Pitts. A logical calculus of the ideas immanent nervous activity. Bulletin of Mathematical Boiphysics, pages 115–133, 1943.

60] M. Minsky and S. Papert. Perceptrons: an introduction to computational geometry. MIT Press, 1969.

61] K. He, X. Zhang, S. Ren, and J. Sun. Deep residual learning for image recognition. CoRR, abs/1512.03385, 2015.

62] Y. LeCun, L. D. Jackel, B. Boser, J. S. Denker, H. P. Graf, I. Guyon, D. Henderson, R. E. Howard, and W. Hubbard. Handwritten digit recognition: Applications of neural net chips and automatic learning. IEEE Communication, pages 41–46, November 1989. invited paper.

63] T. Sadhu. Machine learning: Introduction to the artificial neural network. http://durofy.com/ machine-learning-introduction-to-the-artificial-neural-network/, 2012 (accessed May 13, 2017).

64] A. Krizhevsky, I. Sutskever, and G. E. Hinton. Imagenet classification with deep convolutional neural networks. pages 1106–1114, 2012.

65] A. Karpathy. Cs231n: Convolutional neural networks for visual recognition. http://cs231n.github.io/convolutional-networks/, 2017 (accessed May 13, 2017).

66] T. Dozat. Incorporating nesterov momentum into adam. 2015.

67] D. H. Hubel and T. N. Wiesel. Receptive fields of single neurons in the cat’s striate cortex. Journal of Physiology, 148:574–591, 1959.

68] An image of a traffic sign is filtered by 4 5×5 convolutional kernels. Nvidia Developer; https://devblogs.nvidia.com/parallelforall/ wp-content/uploads/2015/11/fig1.png, 2015 (accessed May 13, 2017).

69] A zero-padded 4 x 4 matrix becomes a 6 x 6 matrix. XRDS Crossroads the ACM Magazine for Students; http://xrds.acm.org/blog/wp-content/ uploads/2016/06/Figure\_3.png, 2016 (accessed May 13, 2017).

70] Max pooling. Intel Developer Zone [online]; https: //software.intel.com/sites/default/files/did\_ feeds images/46c3bfae-84f5-48ed-9412-8c8e9a4df219/ 46c3bfae-84f5-48ed-9412-8c8e9a4df219-imageId= 542924f6-128a-4e45-8c09-b2438e2faec7.png, 2017 (accessed May 13, 2017).

71] N. Srivastava, G. Hinton, A. Krizhevsky, I. Sutskever, and R. Salakhutdinov. Dropout: A simple way to prevent neural networks from overfitting. Journal of Machine Learning Research, 15:1929–1958, 2014.

72] Dropout. http://lamda.nju.edu.cn/weixs/project/CNNTricks/imgs/ dropout.png, 2015 (accessed May 13, 2017).

73] A.Gibiansky. Convolutional neural networks, February2014(accessedMay12, 2017).