

# REAL TIME GENDER RECOGNITION ON FPGA

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**Abstract** - This paper is about how the gender of the person can be detected by using the facial parameters. The parameters such as eyes, jaw, hair, eye brows, and lips are used to detect the gender of the person in the image. The Mat Lab is used to detect the gender of the person in a saved image. The code generated on Mat Lab is then operated on Real-Time basis with the help of National Instrument's myRio FPGA Kit. The Lab VIEW is used to interface the Mat Lab with FPGA Kit. Supporting devices include web cam to acquire the image, LCD to display the result and push button switch to take the image. Gender detection on FPGA has numerous applications in the area of security and surveillance, human-computer intelligent interaction, and smart environment. The proposed method can be further evaluated in the future by using different database and considering more facial parameters.

**Keywords** - Gender Detection, Mat Lab, myRio FPGA kit, Lab View, Math Script module, Vision Development module, and Facial parameters.

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## Introduction

The general definition for gender detection is the genetic or environmental process which is used to specify an individual characteristic physically. The evolution of the gender detection came into existence at the time of increasing the security on the airports. The gender detection kits were also made available on the airports during the high alert situations. Due to advancement of technology gender detection in airport security has become more prominent these days. Even though we have technology to detect the gender of the person, detecting the gender of person with only facial features is still a difficult task.

Gender detection is a very active research topic in the field of computer vision and pattern recognition, which is widely applied in the man-machine interface; visual communication; security and surveillance; and many other aspects. Moreover, Systems that can perform real-time analysis of images are becoming desirable in many applications. It is difficult to deploy these systems in the embedded environment as their power and size requirement are large. Instead of embedded systems we can use FPGAs, as it become an ideal platform for these types of systems because of their size, low-power requirements, and logic programmability. We implemented this system on National Instrument's myRio FPGA kit as this kit can be used in a standalone mode and can be useful to operate the system for real time application.

The gender classification defers by the people coming from different parts of the globe. For example the shape and size of the parameters of the Indian and African is different. Due to changes in the parameter there will be changes in the different features of the face due to this the results of the gender detection are affected. But still we designed the code such that all these parameters are taken under

consideration and we were successful to obtain the accuracy rate of 78 % with 1.9 seconds of propagation delay. Till now face recognition have acquired the accuracy in this field, now gender detection is the extension in this field of study.

## Phase 1

Various techniques were used to classify the gender based on facial information. Accuracy is mainly based on pixel value and geometric facial features. For feature extraction, we mainly consider two types of features. One is global features which are based on the distance between two eyes, the distance between lips to the nose, the distance between jaws to the line joining two eyes, the distance between eye brows to the line joining two eyes. Another one is grid features which are based on skin color, hair color etc. In this work, we consider some of the global features and some grid features.

## Procedure

Initially an image is taken either dynamically through the web cam or from the Sample face database from the computer; to that image Laplace-Gaussian edge Detection is applied. Then, the centroid of the eyes is found in the image by using inbuilt Mat lab function. The center point between two eyes is found to perform further analysis based on that point. From that point a rectangular frame is drawn to identify the position of an eye and the iteration continuous to all features of the face Now, the features are identified and the distances are calculated based on following parameters: Inter-ocular distance, Eyes to Nose distance, Eyes to Jaw distance, Eyes to Lips distance. Based on extracted results the gender classification is done. Other than distance the geometry of the face and the pixel values are also considered to classify the gender of the person in the image. Each facial parameter is given particular value in the percentage and the threshold is decided. The addition

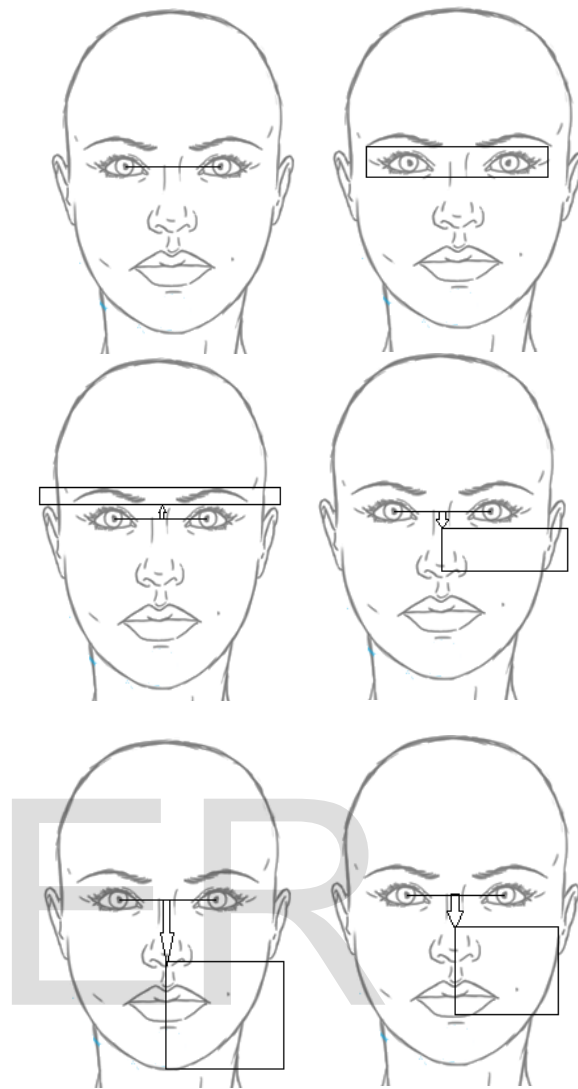
of the values of the parameters if exceed the threshold value, then the gender of the person at the output is detected to be a male or else the output is given as the female.

### Computation of Facial Features

Initially, the facial features are identified for the computation of distances between their features and the area in which that feature lies, decides the gender of an individual by the implementation of classifier; the ratios that will be calculated depending on 5 key parameters of the face. Those are

- a) Center point between the eyes calculated by keeping the center of the eye balls as two points called as centroid.
- b) Position of the eye to carry the further analysis
- c) Distance from centroid to two points above the eyes considering the area of eye brows.
- d) The distance below the eyes to determine the hair around the ear.
- e) Distance from centroid to the nose point and centroid to the jaw consider for determining the shape of the jaw.
- f) Distance from centroid to the two points below the eyes (one of it as bottom of the lips) considering the area for detecting the facial hair.

The number of pixel will vary depending on the size of the eye brows, facial hair and hairs around the ears. In each case particular value is decided as a threshold to make the decision between male and female. The shape of the jaw is also used as one of the factor in gender detection as shown in the figure.

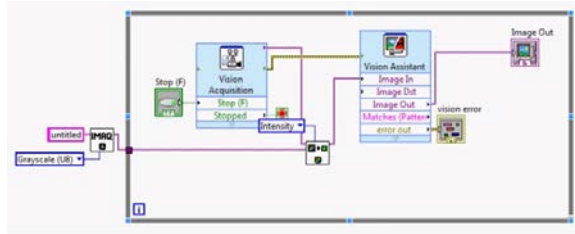


### Phase 2

Lab View is a platform and development environment for a visual programming language from National Instruments. We have used the Lab View 9.0 to interface Mat Lab programming on myRio FPGA. Various Lab View modules and graphical programming was used for this purpose. These modules are as shown below:

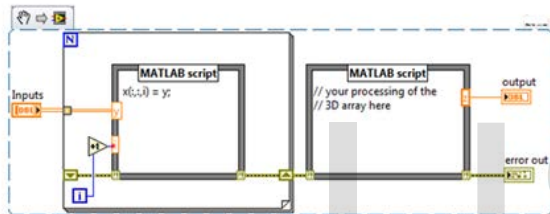
#### a) Vision development module

The Vision Development Module is used to develop and deploy machine vision applications. It includes many functions to acquire images from a multitude of cameras and to process images by enhancing them, checking for presence, locating features, identifying objects, and measuring parts. Vision development module is also used to process the image entering the math script module. In this system we have used it to acquiring the image from the web cam and converted the image into suitable form for further analysis.



**b) Math Script Module**

Math Script Module adds textual math to the Lab View development environment with a native compiler for the .m files you have developed in MATLAB. No extra code generation is required to process .m file in Lab View by the use for this module. This module is designed to process 2D array code from .m file. Therefore, your N-dimensional array can be put into the MATLAB Script Node 2 dimensions at a time using nested For Loops. This is shown in the figure below.



Once your entire array has been loaded into the module, the native MATLAB functions were used to process the arrays. Thus, 3D array can be processed using Math script module.

**c) FPGA Module**

FPGA Module is used for graphical development for FPGA chips on NI reconfigurable I/O (RIO) hardware targets. In this project FPGA module is used to operate the myRio FPGA kit in the stand alone mode.

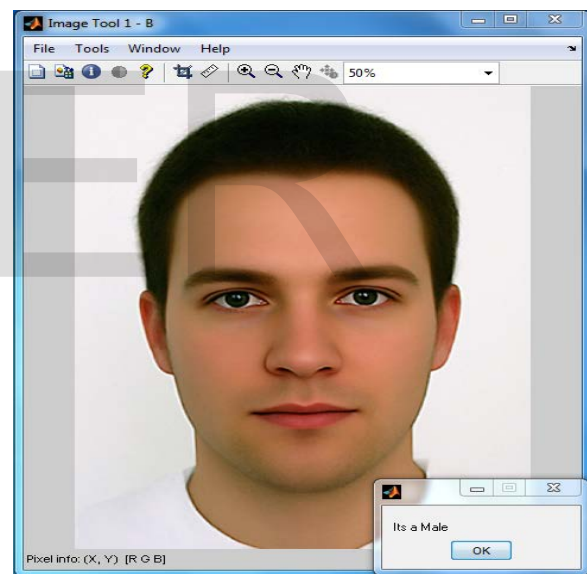
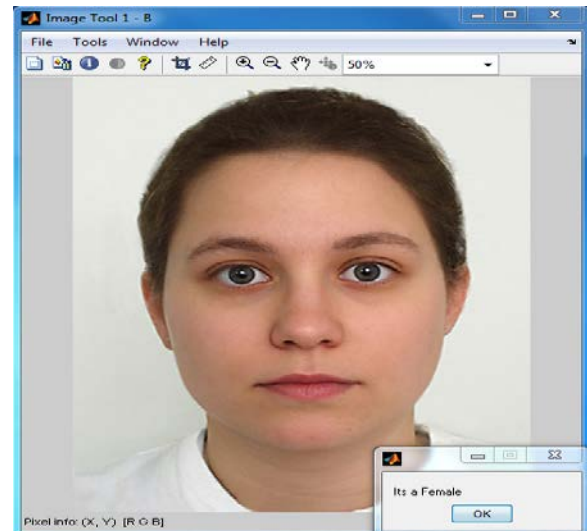
The real time operating device used for this project is National Instruments myRio Kit. It is the Lab View programmable, dual-core ARM Cortex A9 real-time processing and Xilinx FPGA customizable I/O. Nonvolatile memory in this device is used to operate the device in standalone mode. Following ports are used to connect the supporting devices to the FPGA kit.

- a) USB 2.0 for connecting web cam to the FPGA Device.
- b) Expansion Port (MXP) connectors for connecting push button and 16x2 LCD to the FPGA Device.

**Results**

Initial results included detection of the gender of the person in the sample database. Final results included the detection

of the person from the image taken from the web cam connected to myRio FPGA kit. The results were shown on the LCD device connected to the FPGA. The overall system was operated on standalone mode.



**Specifications and Results obtained:**

1)	Accuracy Rate	78%
2)	Propagation Delay	1.9 Sec
3)	Operating Speed	667 MHz
4)	FPGA Type	XilinxZ-7010
5)	Output Voltage	4.75 V to 5.25 V

6)	Maximum current on each connector	100 mA
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## Conclusion

Thus gender recognition on FPGA is the good achievement in the era of computer world. As this system can be operated on real time basis, it has vast applications which will make it more useful in the future. In this paper we have studied the robust method for gender detection by using the facial parameters and also used this method for detecting the gender of the person in real time basis by using FPGA.

## Future Work

The future work will include more robust method considering more parameters for gender detection. Hundreds of samples can be used to compare the results and increase the accuracy rate. The drawbacks of this project are:

- The classification of the person in the image may differ by the race. The people coming from different part of the globe have different features, size, color, and shape.
- The accuracy rate decreases if the person is standing away from the camera than the redefined distance.

These factors may be considered in the future work to build the more robust system.

## References

- [1] Minh Hoai Nguyen ; Perez, J. ; De la Torre, F. "Facial feature detection with optimal pixel reduction SVM". Automatic Face & Gesture Recognition, 2008. FG '08. 8th IEEE International Conference, 17-19 Sept. 2008. Page(s):1 – 6
- [2] Irick, K, DeBole, M. ; Narayanan, V. ; Sharma, R. ; Hankyu Moon ; Mummareddy, S. "A Unified Streaming Architecture for Real Time Face Detection and Gender Classification". FPL, 2007. International Conference on 27-29 Aug. 2007 Page(s): 267 – 272
- [3] Jian-Gang Wang , Wei-Yun Yau. "Real-time beard detection by combining image decolorization and texture detection with applications to facial gender recognition". CIBIM, 2013 IEEE Workshop on 16-19 April 2013. Page(s): 58 – 65
- [4] Jain, A, Huang, J., Shiao-fen Fang. "Gender identification using frontal facial images". Multimedia and Expo, 2005. ICME 2005. IEEE International Conference on Date of Conference: 6-8 July 2005
- [5] <http://www.ni.com/pdf/manuals/376047a.pdf>
- [6] Li-ying Lang, Wei-Wei Gu. "A robustness and real-time face detection algorithm in complex background". Wavelet Analysis and Pattern Recognition, 2009. ICWAPR 2009. International Conference on 12-15 July 2009 Page(s): 22 – 25

- [7] Qian Chen. "Advanced method of face image processing and recognition based on Ssim technology". Mechatronic Sciences, Electric Engineering and Computer (MEC), Proceedings 2013 International Conference on 20-22 Dec. 2013, Page(s): 2500 – 2504
- [8] Heyrman, B. ; Rosse, M. ; Ginhac, D." A 1.3 megapixel FPGA-based smart camera for high dynamic range real time video". Distributed Smart Cameras (ICDSC), 2013 Seventh International Conference on Oct. 29 2013-Nov. 1 2013, Page(s):1 – 6
- [9] Adamo, Oluwayomi." VLSI architecture and FPGA prototyping of a digital camera for image security and authentication". Region 5 Conference, 2006 IEEE 7-9 April 2006 Page(s): 154 – 158
- [10] Zigouris, E. Kalantzopoulos, A. ; Vassalos, E." LabVIEW to CCS Link for Automating Digital Signal & Image Processing Applications". Signals, Circuits and Systems, 2007. ISSCS 2007. International Symposium on (Volume:2 )
- [11] Lita, I. Visan, D.A. ; Cioc, I.B. "LabVIEW application for movement detection using image acquisition and processing". Design and Technology in Electronic Packaging (SIITME), 2010 IEEE 16th International Symposium for 23-26 Sept. 2010, Page(s): 225 – 228
- [12] Wuni Xu , Zhong Lanxiang ; Dingyuan Wang, "Image processing based on seamless integration technology between LabVIEW and MATLAB". Information Networking and Automation (ICINA), 2010 International Conference on (Volume:1)