$$Y(nT) = \frac{2x\ (nT) + x\ (nT\text{-}1) - x\ (nT\text{-}3) - 2x\ (nT\text{-}4)}{8}$$

$$H(z) = \frac{2 + Z^{-1} - Z^{-3} - 2Z^{-4}}{8}$$

This filter introduces a delay of two samples. The output of preprocessing stage is provided to the peak detection stage.

II. Peak Detection: In this algorithm the peak detection is carried out by thresholding method. In this stage the first 400 samples are initially read and threshold is initialized to 30% of maximum value among all 400 samples. Then the input sample is compared with the threshold value, if the sample value is greater than the threshold value then the control moves to the next stage. Like this the point which lies in QRS region are detected. Once these points are detected then they are compared with each other and highest value among them is located.

2.   Results

The results of presented system are obtained by using ECG signal from   MIT BIH database as input. Following are the results of presented ECG QRS Detection Algorithm.
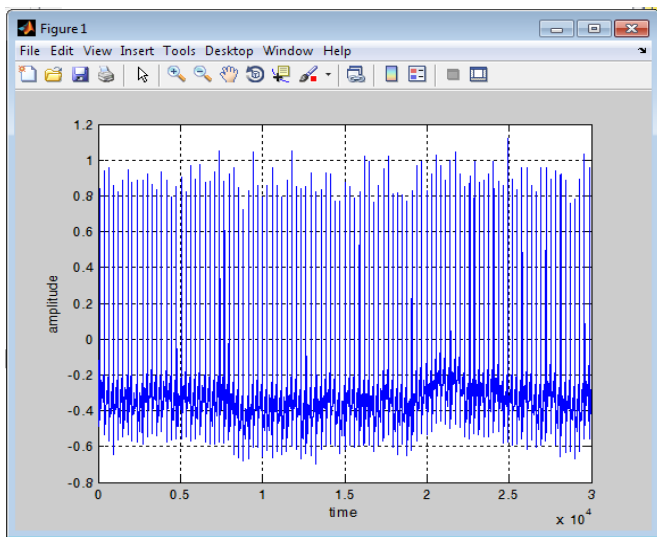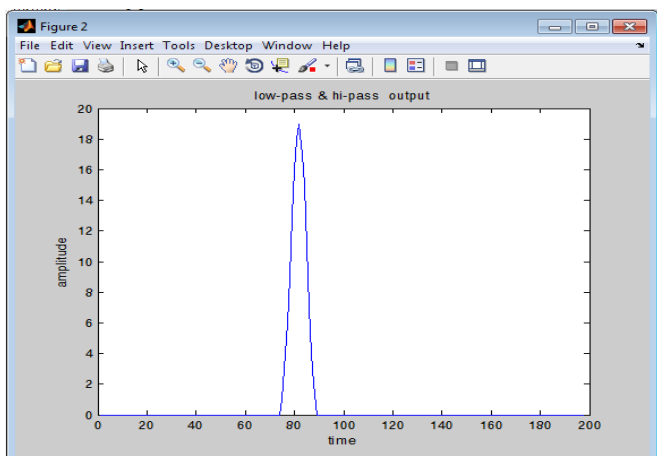

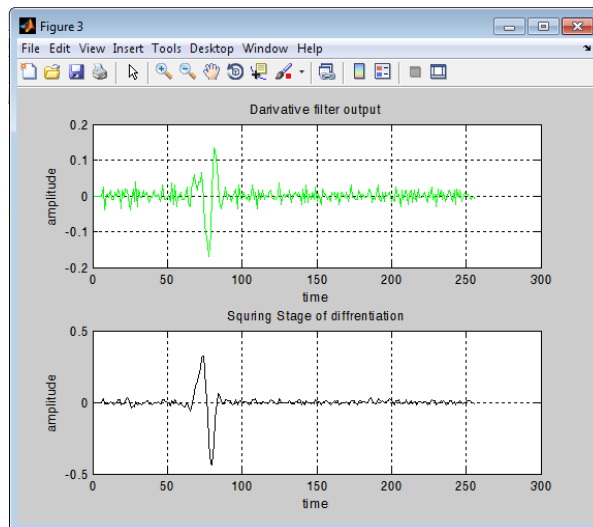**Figure 1:** Input ECG Signal

Figure 2: output of Bandpass Filter
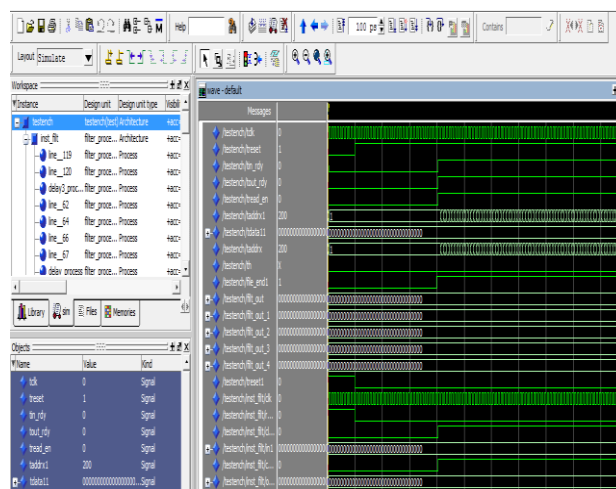

Figure 3: Output of Derivative and Squaring Filter

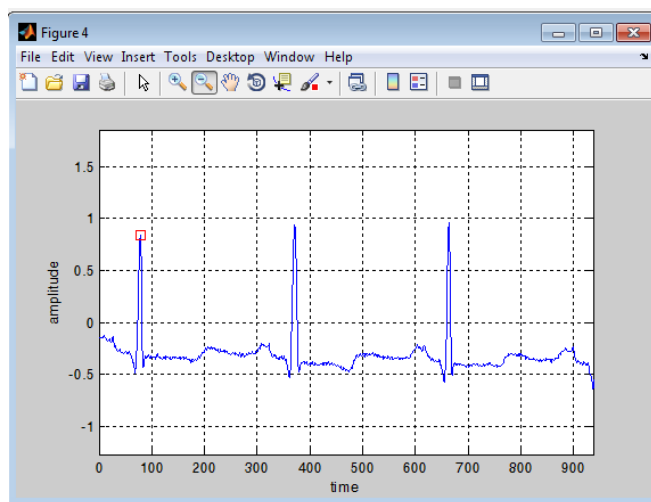**Figure 4:** Output of QRS Detection Algorithm in Modelsim.

Figure 5: Output of QRS Detection Algorithm in Matlab

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3. Conclusion

This paper has presented a novel algorithm for QRS detection based on filtering and thresholding and its implementation. The algorithm is evaluated with MIT/BIH standard ECG database to achieve a good detection rate and accuracy. The obtained results of the system are compared and validated by an expert cardiologist.

References

[1] JIAPU Pan, Wills J.Tompkins "A real Time QRS Detection Algorithm" IEEE Transactions on biomedical Engineering, vol.BME-32.

[2] William Sandham, David Hamilton, Pablo Laguna, andMaurice ,Cohen "Advances in Electrocardiogram Signal Processing and Analysis". Hindawi Publishing Corporation EURASIP Journal on Advances in Signal Processing Volume 2007

[3] Ashish Shukla "Hardware Implementation of Real Time ECG Analysis Algorithm" http://scholarspace.manoa.hawaii.edu/handle/10125/205 76.

[4] Chris F. Zhang and Tae-wuk, Bae "VLSI Friendly ECG QRS Complex Detector for Body Sensor Network" Vol 2,No.1March 2012

[5] F.Zhang &Y.Lin "Novel QRS Detection by CWT for ECG sensor"in proc.int.conferenceIEEE Biomedcircuit system montrael Canada nov 2012.

[6] S.Sumathi1, Dr.M.Y. Sanavullah2 "Comparative Study of QRS Complex Detection in ECG" International Journal of Recent Trends in Engineering, Vol2, No. 5, November 2009

[7] A text book on "Advances In Electrocardiograms Clinical Applications". edited by Richard M. Millis

[8] Sameer K. Salih, S. A. Aljunid, Abid ,Yahya and Khalid Ghailan **"**A Novel Approach for Detecting QRS Complex of ECG signal". IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 6, No 3, November 2012

[9] K.V.L.Narayana, A.Bhujanga Rao "Wavelet based QRS detection in ECG using MATLAB" Innovative Systems Design and Engineering ISSN 2222-1727 (Paper) ISSN 2222-2871 (Online) Vol 2, No 7, 2011

[10] A textbook on Practical Electrocardiography

[11] Y. T. Chiang and K. S. Fu, "Parallel parsing algorithms and VLSI implementation for syntactic pattern recognition," IEEE Trans. Pattern Anal. Mach. Intell, *PAMI-7, no 3, pp.* 302- 313, 1985.

[12] Szi-Wen Chen, Hsiao-Chen Chen, Hsiao-Lung Chan *"*A real-time QRS detection method based on moving-averaging incorporating with wavelet denoising*" ELESVIER* journal vol2, special issue1.

[13] Neha Joshi, Preet Jain "ECG Based Heart Rate Monitoring System Implementation Using FPGA For Low Power Devices And Applications" International Journal of Research in Engineering and Technology.

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