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BIST for Reconfigurable System on Chip (SOC) for Micro-Vibration Measurement

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Abstract: This paper presents methodology for testing mixed signal circuits in the SOC configured for micro vibration measurement. The SOC for micro vibration measurement contains a Bi morph sensor and front end electronics containing an amplifier, peak detector interface with A/D converter and memory. The amplifier is tested by applying triangular stimuli input generated by Test Pattern Generator (TPG) configured in the FPGA. The peak detector is tested by applying a test pulses generated by test generator system. The outputs of the test circuit are analyzed by output response analyzer (ORA) in the FPGA. The required hardware for testing analog as well as digital circuits of the SOC are configured by the on chip portion of FPGA and FPAA. The whole SOC can be tested by applying stimuli generated in TPG and checking the output by comparing patterns stored in memory with reference pattern using ORA. Simulation results are reported for counter and test ADC.

Keywords: Output Response Analyzer, Test Pattern Generator, SoC and FPAA.

INTRODUCTION

Testing is an important activity at different levels to validate a design. In normal case the complete testing of a mixed signal integrated circuit occupies a large area and power. A mixed signal circuit needs analog as well as digital stimuli to test its different portion. There are various approaches for testing mixed signal circuits.

The faults occurring in analog circuits can be categorized as hard faults and soft faults. The hard faults (Catastrophic) are those which categorize circuit performance to differ catastrophically different than normal performance [1,2]. A catastrophic fault is similar to stuck at fault in digital test domain where every component can either stuck open are stuck short. A stuck fault occurs when component output is not connected to rest of the circuit. The stuck short fault occurs when component output is shorted. The soft fault refers to changes in a circuit that do not affect it connectivity but results in circuit function out of specification.

The important test approaches is based on oscillation built in self test. In this type of test circuit is converted in to an oscillator and its parameter like oscillation frequency is determined.

These parameters are compared with parameter of simulated test circuit and suitability of a circuit under test is determined. For this the fault is injected in the circuit under test and testing can be done for all types of faults. In our work a reconfigurable system on chip (shown in figure 1) has been simulated by configuring digital portion in FPGA and analog portion in FPAA. Implementation on FPGA and FPAA is done for rapid proto typing and in future, one can get ASIC fabricated for this system. The amplifier and peak detector and other analog circuits are tested by applying test stimuli generated by TPG and the output of Device Under Test (DUT) is analyzed by Output Response Analyzer (ORA). The whole BIST hardware is configured on existing FPGA and FPAA resources available on SOC. The section II presents BIST architecture and operation. The detailed descriptions of test pattern generator (TPG) and ORA are given in section III and IV. Section V reports simulation results for testing different parts of SOC. Section VI presents conclusion.

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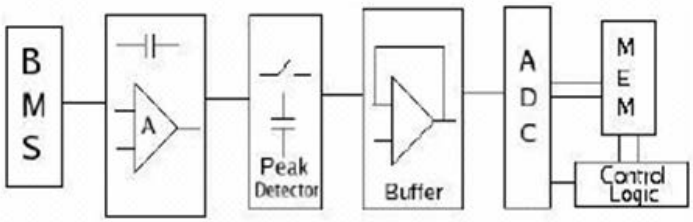

Figure 1: Vibration Monitoring Reconfigurable SOC

BIST ARCHITECTURE AND OPERATION

Following portion discusses the BIST configuration for various part of the SOC.

BIST Configuration for Peak Detector

For detection of fault in capacitor, we are proposing a system consist of a constant current source, a switch to control the charging of the capacitor, comparator which will compare the results stored in ROM, and using ADC of the SOC. The sequence of test is as follows:

1. A defined period of the pulse is applied, so that, capacitor will get charged to known voltage, which will be converted to digital through ADC and the value is analyzed by ORA from the value stored in ROM as shown in figure 2.

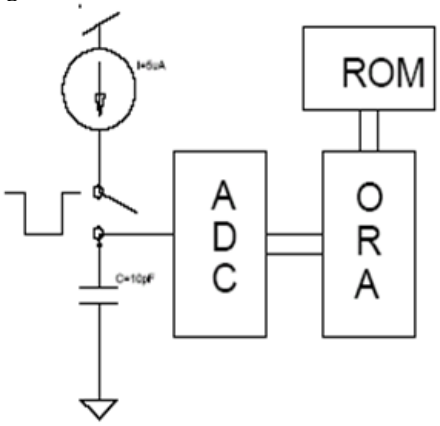

Figure 2: Test Configurable for Peak Detector

2. The catastrophic faults are also tested from the proposed test structure, if the capacitor is shorted then ADC output will be zero, and if capacitor is open then, ADC output will show a fixed value despite of any period of the applied pulse.

BIST Configuration for Amplifier

For analyzing amplifier, a triangular waveform is generated using test pattern generator and applied to the DUT (configured as amplifier), and the output of DUT is then fed to ADC and output of ADC is analyzed using ORA with delayed value of test pattern generator. In case of any discrepancies in these outputs, the ORA will signal the fault condition. BIST configuration of amplifier is shown in figure 3.

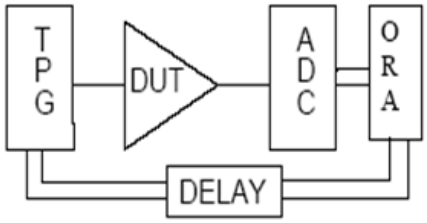

Figure 3: The BIST Configurable for Amplifier

BIST Configuration for Complete System

In order to test the complete SOC, the different stimuli is generated to simulate various vibration signal using Test Pattern Generator (TPG) containing linear feedback shift register and counter, the output of Linear Feedback Shift Register (LFSR) is fed to DAC and Low Pass Filter (LPF) to generate required stimuli. The output of test pattern generator is applied to DUT to monitor the fault condition by using ORA as shown in figure 4.

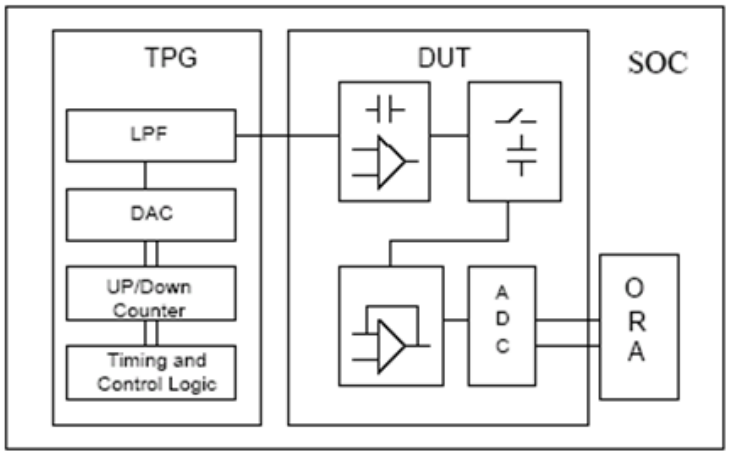

Figure 4: BIST Configuration of Complete System

TEST PATTERN GENERATOR

The test pattern generator consists of up/down counter with its output fed to digital to analog converter. The analog output of DAC is filtered by using a low pass filter. The low pass filter is configured using a CAB of FPAA. The up/down counter and its timing and control logic is configured using FPGA as shown in figure 5.

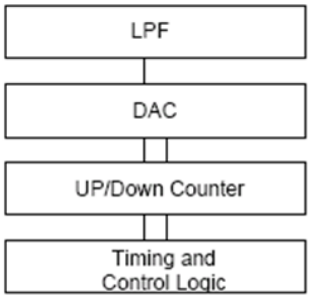

Figure 5: Test Pattern Generator

OUTPUT RESPONSE ANALYZER (ORA)

The ORA analyzes the output of the ADC from the value code generated from TPG by subtracting them. The accumulator in the ORA determines the pass/fail status of the BIST by expecting the final sum to be within a predetermine range of values [3]. One of the advantages of digital ORA is that, the results can be directly read from the system digital interfaces during system level testing. The size of the double precision accumulator should at least 16 bits when ADC and DAC are less then 8 bits. The figure 6 shows the configuration of ORA.

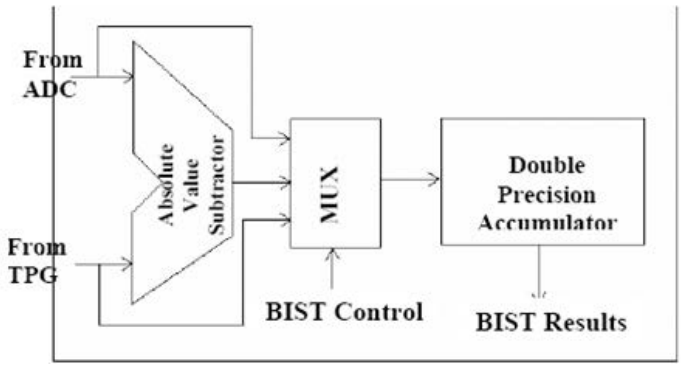

Figure 6: ORA Configuration

SIMULATION RESULTS

A 10 bit counter is designed as a part of test pattern generator and is operated in up counting mode. Figure 7 shows 10 bit outputs of this counter. This counter will be used to generate test stimuli for testing different part of test system.

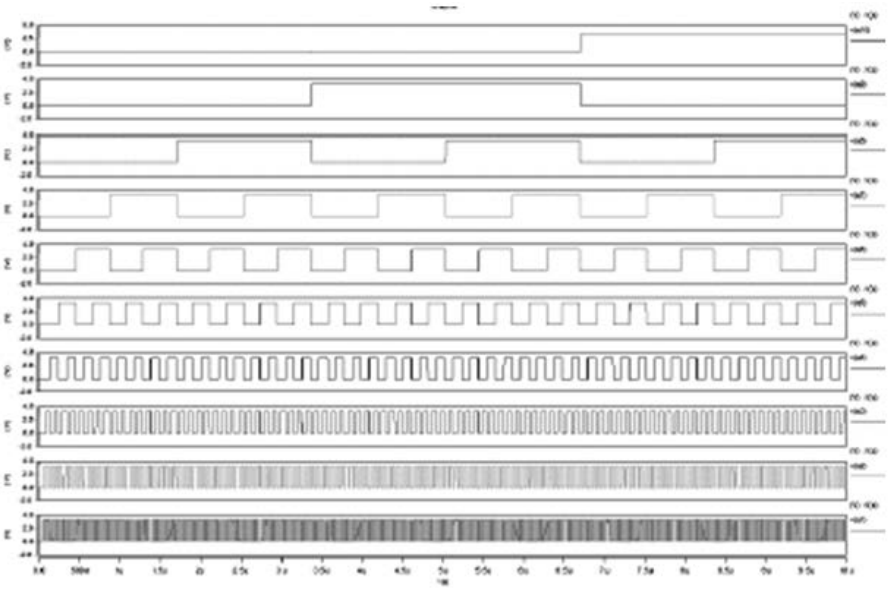

Figure 7: Plot of Outputs 10 Bit Counter

A 7 bit ADC is designed and a simulated test pattern which is shown on the top of figure 8 is applied at the input of this ADC. The 7 bit outputs of ADC are shown in figure 8 in response to this stimulus.

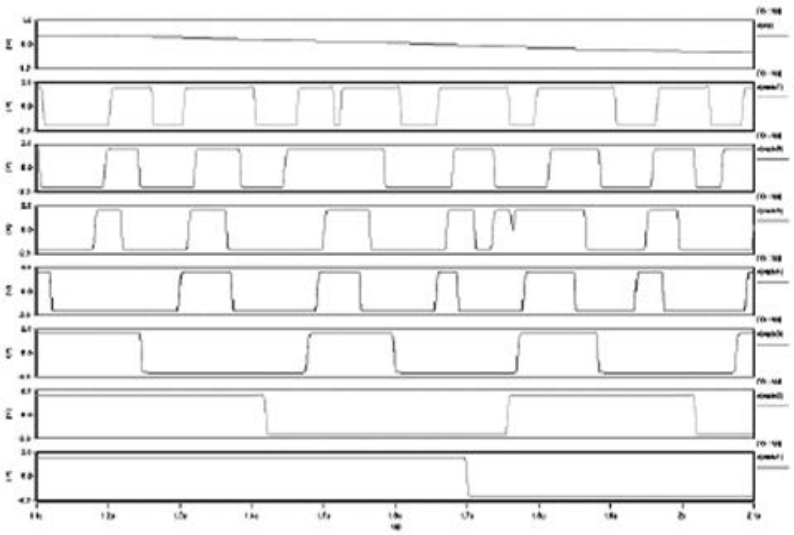

Figure 8: Plot of Output of 7 bit ADC in Response to Test Stimuli

CONCLUSION

The BIST architecture for different portion of vibration monitoring system is discussed in the paper. With the help of this arrangement stuck open and stuck short fault in different part of the system can be detected. Simulations of different faults in the test circuit are done by injecting faults. The stimuli required for testing are generated using TPG, which in turn generates different arbitrarily signals using counter and LFSR. The ORA analyzes the responses from ADC and TPG in the digital domain and generates the pass/fail status signal about the test circuit.

REFERENCES

[1] Das, J., Das, M. P., & Velusamy, P. (2013). Sesbania grandiflora leaf extract mediated green synthesis of antibacterial silver nanoparticles against selected human pathogens. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, *104*, 265-270.

[2] Umanath, K.P.S.S.K., Palanikumar, K., & Selvamani, S.T. (2013). Analysis of dry sliding wear behaviour of Al6061/SiC/Al2O3 hybrid metal matrix composites. *Composites Part B: Engineering*, *53*, 159-168.

[3] Udayakumar, R., Khanaa, V., Saravanan, T., & Saritha, G. (1786). Cross layer optimization for wireless network (WIMAX). *Middle-East Journal of Scientific Research*, *16*(12), 1786-1789.

[4] Kumaravel, A., & Rangarajan, K. (2013). Algorithm for automaton specification for exploring dynamic labyrinths. *Indian Journal of Science and Technology*, *6*(5S), 4554-4559.

[5] Pieger, S., Salman, A., & Bidra, A.S. (2014). Clinical outcomes of lithium disilicate single crowns and partial fixed dental prostheses: a systematic review. *The Journal of prosthetic dentistry*, *112*(1), 22-30.

[6] Vijayaraghavan, K., Nalini, S.K., Prakash, N.U., & Madhankumar, D. (2012). One step green synthesis of silver nano/microparticles using extracts of Trachyspermum ammi and Papaver somniferum. *Colloids and Surfaces B: Biointerfaces*, *94*, 114-117.

[7] Khanaa, V., Mohanta, K., & Satheesh, B. (2013). Comparative study of uwb communications over fiber using direct and external modulations. *Indian Journal of Science and Technology*, *6*(6), 4845-4847.

[8] Khanaa, V., Thooyamani, K. P., & Udayakumar, R. (1798). Cognitive radio based network for ISM band real time embedded system. *Middle-East Journal of Scientific Research*, *16*(12), 1798-1800.

[9] Vijayaraghavan, K., Nalini, S.K., Prakash, N.U., & Madhankumar, D. (2012). Biomimetic synthesis of silver nanoparticles by aqueous extract of Syzygium aromaticum. *Materials Letters*, *75*, 33-35

[10] Caroline, M.L., Sankar, R., Indirani, R.M., & Vasudevan, S. (2009). Growth, optical, thermal and dielectric studies of an amino acid organic nonlinear optical material: l-Alanine. *Materials Chemistry and Physics*, *114*(1), 490-494.

[11] Kumaravel, A., & Pradeepa, R. (2013). Efficient molecule reduction for drug design by intelligent search methods. *International Journal of Pharma and Bio Sciences*, *4*(2), B1023-B1029.

[12] Kaviyarasu, K., Manikandan, E., Kennedy, J., Jayachandran, M., Ladchumananandasiivam, R., De Gomes, U. U., & Maaza, M. (2016). Synthesis and characterization studies of NiO nanorods for enhancing solar cell efficiency using photon upconversion materials. *Ceramics International*, *42*(7), 8385-8394.

[13] Sengottuvel, P., Satishkumar, S., & Dinakaran, D. (2013). Optimization of multiple characteristics of EDM parameters based on desirability approach and fuzzy modeling. *Procedia Engineering*, *64*, 1069-1078.

[14] Anbuselvi S., Chellaram, C., Jonesh S., Jayanthi L., & Edward J.K.P. (2009). Bioactive potential of coral associated gastropod, Trochus tentorium of Gulf of Mannar, Southeastern India. *J. Med. Sci,* 9(5), 240-244.

[15] Kaviyarasu, K., Ayeshamariam, A., Manikandan, E., Kennedy, J., Ladchumananandasivam, R., Gomes, U. U., & Maaza, M. (2016). Solution processing of CuSe quantum dots: Photocatalytic activity under RhB for UV and visible-light solar irradiation. *Materials Science and Engineering: B*, *210*, 1-9.

[16] Kumaravel, A., & Udayakumar, R. (2013). Web portal visits patterns predicted by intuitionistic fuzzy approach. *Indian Journal of Science and Technology*, *6*(5S), 4549-4553.

[17] Srinivasan, V., & Saravanan, T. (2013). Reformation and market design of power sector. *Middle-East Journal of Scientific Research*, *16*(12), 1763-1767.

[18] Kaviyarasu, K., Manikandan, E., Kennedy, J., & Maaza, M. (2015). A comparative study on the morphological features of highly ordered MgO: AgO nanocube arrays prepared via a hydrothermal method. *RSC Advances*, *5*(100), 82421-82428.

[19] Kumaravel, A., & Udhayakumarapandian, D. (2013). Consruction of meta classifiers for apple scab infections. *International Journal of Pharma and Bio Sciences*, *4*(4), B1207-B1213.

[20] Sankari, S. L., Masthan, K. M. K., Babu, N. A., Bhattacharjee, T., & Elumalai, M. (2012). Apoptosis in cancer-an update. *Asian Pacific journal of cancer prevention*, *13*(10), 4873-4878

[21] Harish, B. N., & Menezes, G. A. (2011). Antimicrobial resistance in typhoidal salmonellae. *Indian journal of medical microbiology*, *29*(3), 223-229.

[22] Manikandan, A., Manikandan, E., Meenatchi, B., Vadivel, S., Jaganathan, S. K., Ladchumananandasivam, R., & Aanand, J. S. (2017). Rare earth element (REE) lanthanum doped zinc oxide (La: ZnO) nanomaterials: synthesis structural optical and antibacterial studies. *Journal of Alloys and Compounds*, *723*, 1155-1161.

[23] Caroline, M. L., & Vasudevan, S. (2008). Growth and characterization of an organic nonlinear optical material: L-alanine alaninium nitrate. *Materials Letters*, *62*(15), 2245-2248.

[24] Saravanan T., Srinivasan V., Udayakumar R. (2013). A approach for visualization of atherosclerosis in coronary artery, Middle - East Journal of Scientific Research, 18(12), 1713-1717.

[25] Poongothai, S., Ilavarasan, R., & Karrunakaran, C.M. (2010). Simultaneous and accurate determination of vitamins B1, B6, B12 and alpha-lipoic acid in multivitamin capsule by reverse-phase high performance liquid chromatographic method. *International Journal of Pharmacy and Pharmaceutical Sciences*, *2*(4), 133-139.

[26] Udayakumar, R., Khanaa, V., & Saravanan, T. (2013). Synthesis and structural characterization of thin films of SnO 2 prepared by spray pyrolysis technique. *Indian Journal of Science and Technology*, *6*(6), 4754-4757

[27] Anbazhagan, R., Satheesh, B., & Gopalakrishnan, K. (2013). Mathematical modeling and simulation of modern cars in the role of stability analysis. *Indian Journal of Science and Technology*, *6*(5S), 4633-4641.

[28] Caroline, M.L., & Vasudevan, S. (2009). Growth and characterization of bis thiourea cadmium iodide: A semiorganic single crystal. *Materials Chemistry and Physics*, *113*(2-3), 670-674.

[29] Sharmila, S., Jeyanthi Rebecca, L., & Das, M. P. (2012). Production of Biodiesel from Chaetomorpha antennina and Gracilaria corticata. *Journal of Chemical and Pharmaceutical Research*, *4*(11), 4870-4874.

[30] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2013). An integrated agent system for e-mail coordination using jade. *Indian Journal of Science and Technology*, *6*(6), 4758-4761.

[31] Caroline, M. L., Kandasamy, A., Mohan, R., & Vasudevan, S. (2009). Growth and characterization of dichlorobis l-proline Zn (II): A semiorganic nonlinear optical single crystal. *Journal of Crystal Growth*, *311*(4), 1161-1165.

[32] Caroline, M.L., & Vasudevan, S. (2009). Growth and characterization of L-phenylalanine nitric acid, a new organic nonlinear optical material. *Materials Letters*, *63*(1), 41-44.

[33] Kaviyarasu, K., Xolile Fuku, Genene T. Mola, E. Manikandan, J. Kennedy, and M. Maaza. Photoluminescence of well-aligned ZnO doped CeO2 nanoplatelets by a solvothermal route. *Materials Letters*, *183*(2016), 351-354.

[34] Saravanan, T., & Saritha, G. (2013). Buck converter with a variable number of predictive current distributing method. *Indian Journal of Science and Technology*, *6*(5S), 4583-4588.

[35] Parthasarathy, R., Ilavarasan, R., & Karrunakaran, C. M. (2009). Antidiabetic activity of Thespesia Populnea bark and leaf extract against streptozotocin induced diabetic rats. *International Journal of PharmTech Research*, *1*(4), 1069-1072.

[36] Hanirex, D. K., & Kaliyamurthie, K. P. (2013). Multi-classification approach for detecting thyroid attacks. *International Journal of Pharma and Bio Sciences,* 4(3), B1246-B1251

[37] Kandasamy, A., Mohan, R., Lydia Caroline, M., & Vasudevan, S. (2008). Nucleation kinetics, growth, solubility and dielectric studies of L-proline cadmium chloride monohydrate semi organic nonlinear optical single crystal. *Crystal Research and Technology: Journal of Experimental and Industrial Crystallography*, *43*(2), 186-192.

[38] Srinivasan, V., Saravanan, T., Udayakumar, R., & Saritha, G. (2013). Specific absorption rate in the cell phone user's head. *Middle-East Journal of Scientific Research*, *16*(12), 1748-50.

[39] Udayakumar R., Khanaa V., & Saravanan T. (2013). Chromatic dispersion compensation in optical fiber communication system and its simulation, Indian Journal of Science and Technology, 6(6), 4762-4766.

[40] Vijayaragavan, S.P., Karthik, B., Kiran, T.V.U., & Sundar Raj, M. (1990). Robotic surveillance for patient care in hospitals. *Middle-East Journal of Scientific Research*, *16*(12), 1820-1824.

[41] Nejad, N.D.(2015). Diagnosis of heart disease and hyperacidity of stomach through iridology based on the neural network. *International Academic Journal of Science and Engineering, 2*(6), 17-25.

[42] Vazralu, M., & Jacob, N. (2018). Localization in Wireless Sensor Networks Using Reach Centroid Algorithm. *Bonfring International Journal of Networking Technologies and Applications, 5*(2), 6-8.

[43] Subha Lakshmi, N., and Sarumathi, S. (2018). Analysis of Circuit Breaker and Relays in Substations. *Bonfring International Journal of Power Systems and Integrated Circuits, 8*(1), 1-4.

[44] Prabha, B. (2014). H Cloud Modeling and Analysis of Reliable Services for Green Area with Energy Efficiency. *International Scientific Journal on Science Engineering & Technology, 17*(10), 926-934.

[45] Agrawal, S., & Gupta, H. (2014). State-of-the-Art on Cloud Ontology. *International Scientific Journal on Science Engineering & Technology, 17*(10), 898-904.

[46] Cyrus, A., & Nyakomitta, P.S. (2014). Multiple Human Tracking in Surveillance Videos. *The SIJ Transactions on Computer Science Engineering & its Applications, 2*(6), 1-6.

[47] Ayanga, M.A., Sigey, J.K., Okelo, J.A., Okwoyo, J.M., & Giterere, K. (2016). Energy Crisis Way-Forward: Diesel Generator-Micro Hydro-Solar Hybrid Power System of Off-Grid Power Station for Rural Development. *The SIJ Transactions on Computer Science Engineering & its Applications, 4*(2), 10-17.

[48] Krishnan, M., Haripriya, Arunadevi, & Deepthi, (2019). Security Enhancement and time delay consumption for cloud computing using AES and RC6 algorithm. *Bonfring International Journal of Software Engineering and Soft Computing, 9*(1), 1-6.

[49] Saravanakumar, R., Lavanya, K., Pavithra, B., Punithavalli, B., & Revathi, P. (2017).A Wide Input Range Dual Path CMOS Rectifier for RF Energy Harvesting. *The SIJ Transactions on Computer Networks & Communication Engineering (CNCE), 5*(1), 5-8.

[50] Parimala, A., Lokpriya, S., Revathi, R., Kaviyarasi, I., & Meena, M.(2017). Energy-Efficient Resource Allocation and Spectrum Sensing for Heterogeneous Cognitive Radio Network based on Two-Tier Crossover Genetic Algorithm. *The SIJ Transactions on Computer Networks & Communication Engineering (CNCE), 5*(1), 9-15.