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Research Article

Power enhanced cognitive radio implementation

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ABSTRACT
There is an enormous development of wireless communications in the past few years. Due to this frequency spectrum is becoming a very precious resource and insufficiency of the spectrum is a serious problem. So, there is a need to improve the utilization of spectrum effectively. Cognitive radio has demonstrated to be a successful innovation for catching the range, yet additionally for utilizing it. Spectrum sensing can be achieved utilizing a traditional energy identification method that utilizes a single threshold to identify the nearness or nonappearance of the signal, yet whose performance degrades when the SNR is low. To overcome this issue, researchers provide twofold threshold-based spectrum sensing, which looks at the history of sensing in the confusion zone. The test results are compared to these two levels, and a judgement is made on whether main users should be present. In simulations, the suggested double threshold approach outperforms both the double and single threshold detection methods. We investigated spectrum allocation and efficiency using the proposed double threshold method.

Keywords: Cognitive radio; Double Threshold; Energy Detection; Spectrum Allocation; Spectrum Sensing.

I. Introduction

The basic goal of every communication system is to optimise network capacity. In wireless communication system spectrum utilization plays a vital role. To improve spectrum utilization cognitive radio network is a new model for designing wireless communication. The basic goal of cognitive radio is to increase spectrum utilisation through better spectrum sharing [1]-[19].

The cognitive terminals constantly monitor accessibility and provide services to primary users without interfering in any way. Primary users have the highest priority or rights to use a certain spectrum band. Though secondary users have the least need, they are allowed to use the range without interfering with prime users. As a result, secondary users should have intelligent radio capabilities, such as correctly detecting the range to see if it is being used by the primary user and changing the radio parameters to use the unused portion of the range [1-5].

For spectrum sensing, many methods have been proposed. Because of its computational and implementation simplicity, conventional energy detection has been frequently employed among these techniques. It detects the overall energy received in a transmission by the cognitive radio [20]-[28]. The primary user is present if the signal's energy surpasses a certain level. If the energy level falls below that threshold, the principal user is considered to be absent [29]-[38].

However, due to the effect of noise uncertainty, this technique is worsening, especially in low SNR situations. In addition, if the detection threshold is set incorrectly, the detection performance may suffer. The method of re-sensing is utilised in this research to solve the challenges created by noise uncertainty. Re-sensing is done by increasing the number of samples used in the twofold threshold calculation. In classic calculations for identifying energy with a single threshold, the Neyman-Pearson rule is used as a single threshold. The spectrum is considered to be occupied when the energy of the received signal V exceeds the identifying edge Vth, and unoccupied when the threshold is less than V_{th} [6]-[9].

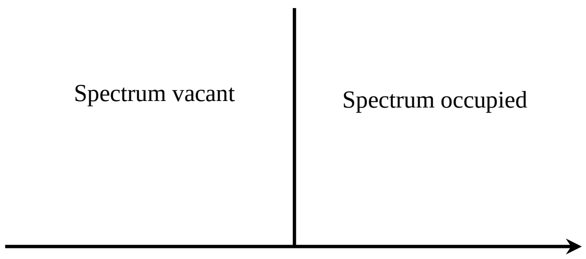

Fig. 1. Single threshold model

In contrast to Fig. 2, the Fig. 2 demonstrates a double threshold model in which the principal user is detected using two thresholds, V_{th0} and V_{th1}, in the event that energy is more prominent than V_{th0}, at that point primary user is available, on the off chance that energy is under V_{th1}, at that point the primary user is supposed to be missing and in the event that energy lies somewhere in the range of V_{th0} and V_{th1}, at that point re-sensing is performed [10]-[12].

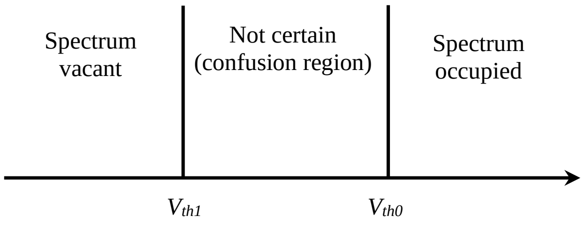

Fig. 2. Proposed method

II. Single Threshold Model

The Neyman-Pearson rule is utilized as a single threshold in traditional calculations for identifying energy with single threshold. On the off chance that the energy of the received signal V is more noteworthy than the identification edge Vth, it is inferred that the main user is spoken to, spoke to by H1, on the opposite the primary user isn't spoken to, spoke to by H0 [39]-[44]. Energy recognition is one of the least demanding and most well-known spectrum detecting method. Test estimations for energy detector are specified as follows:

$$T(y) = \frac{1}{N}\sum_{n=1}^{N} |y(n)|^2 \quad (1)$$

The test measurement T (y) is a chi square with 2N degrees of opportunity distributed by the theory H0. The probability of location and the probability of a false alert are given as

$$P_{fa} = P_r\{T(y) > V_{th} | H_0\} \quad (2)$$

$$P_d = P_r\{T(y) > V_{th} | H_1\} \quad (3)$$

Detection performance is measured by two parameters, Pfa and Pd. On the off chance that the test measurement is over the threshold, the sign is thought to be available and if the test measurement is beneath the threshold, the sign is thought to be absent [13]-[15].

III. Proposed Method

To analyze the probability of detection, the probability of false alarms and their relationships. In conventional energy sensing technology, secondary users make their choice by relating statistics with a predetermined threshold, considered as follows

$$V_{th} = \left\{ Q^{-1}(P_f)\sqrt{\frac{2}{N}} + 1 \right\} \sigma_n^2 \quad (4)$$

N is number of samples, σn2 noise variance and

$$Q(Z) = \int_{Z}^{\infty} \frac{1}{\sqrt{2\pi}} e^{\frac{-x^2}{2}} \quad (5)$$

The dual threshold detection method uses two threshold values to decide whether the signal is present or not

$T(y) < V_{th1}$: decide H0

$V_{th0} < T(y) < V_{th1}$: Re-sensing

$T(y) > V_{th0}$: Re-sensing

Vth1 and Vth0 are thresholds to which the test statistics must be equated by means of the Bayesian approach. A choice is made in favor of H1

$$p(H_1 | y_1, y_2, K\ y_m) = \frac{p(y_1, y_2, K\ y_m | H_1) p(H_1)}{p(y_1, y_2, K\ y_m) p(H_0) + p(y_1, y_2, K\ y_m) p(H_1)} \quad (6)$$

$$T(y) = \frac{p(y_1, y_2, K\ y_m | H_1)}{p(y_1, y_2, K\ y_m) p(H_0)} \quad (7)$$

$$T(y) > \frac{V_{th0}}{1 - V_{th0}} \frac{p(H_0)}{p(H_1)} \quad (8)$$

$$T(y) > \frac{V_{th1}}{1 - V_{th1}} \frac{p(H_0)}{p(H_1)} \quad (9)$$

The conventional energy detector has only one threshold, the exact threshold that arrives at the target probabilities of bogus alarm and recognition due to incorrect parameter estimates, e.g. B. The noise

estimation mistake may not be calculated precisely utilizing threshold selection methods.
The selected threshold can then be specified as uncertainty. This threshold vulnerability can essentially affect expected detection execution. On the off chance that the threshold uncertainty range can be decreased, a dependable choice from the energy detector can be normal. This thought inspires the double threshold detector.
An additional detection threshold has been integrated into the classic single-threshold energy identification algorithm. It turns into a dual threshold energy recognition calculation with two identification thresholds (Vth0 and Vth1). The main user is recognized exactly when V> Vth1 and is not displayed exactly when V<Vth0, corresponding to H1 or H0.

IV. Proposed Double Threshold

The proposed double threshold procedure re- detects. In the event that the test measurement is between the two threshold values, a new acquisition must be made. Here, this reacquisition is achieved by expanding the estimation of the quantity of tests taken with the double threshold method. Both thresholds are assumed to be 2% above and underneath the confusion zone. On the off chance that the edge is over the edge, the primary user would be available. On the off chance that it is lower than this measurement, it is supposed to be missing, when it should lie between the two recognition thresholds.
Although the double-threshold energy recognition algorithm is somewhat poorer, the cognitive radio system actually focuses on the fact that the intervention of the cognitive user with the main user is less than the temperature that the efficiency spectrum is good, performance and spectral efficiency in the detection of energy with two thresholds.
From the proposed the performance gauge for the detection probability, false alarm probability and lost probability for double threshold strategy determined using

$$p_d^{'} = P_r\left(Vu > \frac{V_{th1}}{H_1}\right) = Q\left(\frac{f\,2yfV_{th1}}{u}\right)$$
(10)

$$p_f^{'} = P_r\left(V > \frac{V_{th1}}{H_0}\right) = \left(\frac{u\,\frac{V_{th1}}{2}}{T(u)}\right)$$
(11)

$$p_N^{u} = P_r\left(V^{u} \leq \frac{V_{th1}}{H_1}\right) = 1 - P_d^{u}$$
(12)

Here p'_d is the accurate detection probability when the primary user is present. p'_f is the probability that the primary user is detected as present, when in detail it is not present. p_u is the probability that the primary user is perhaps not detected, when in detail it is present.
As per our proposed improved dual threshold energy detector, we use dual threshold values (V_{th0}, V_{th1}) in a developed energy detector. By including the advantage of a lower collision probability of the double threshold algorithm with the benefit of a improved detection of a better energy detection than the spectrum detection, better performances are obtained, this is obtained with the energy detection technique of spectrum detection. The equations for collision probability, false alarm, detection probability and spectrum unavailable probability are given as follows:
The following equation represents the probability of collision

$$P_c = P_r\,(V < V_{th0}/H_0)$$
(13)

The probability of the spectrum non-availability is obtained by the following equation

$$P_{na} = P_r\,(V > V_{th0}/H_0)$$
(14)

Below equation represents the probability of false alarm in the proposed model

$$P_f = P_r\,(V > V_{th1}/H_0)$$
(15)

$$P_d = P_r\,(V > V_{th1}/H_1)$$
(16)

The above equation shows the expression of the probability of recognition of the spectrum by the acquisition of the double threshold spectrum proposed in a cognitive radio network. The double threshold system can expand the degrees of freedom available. The dual threshold energy detector is superior than the ordinary energy detector in cooperative spectrum securing systems with an *OR* rule. This technique not only minimizes the overall energy consumption of the network in the discovery phase, but also lessens network traffic by maintaining strategic reports from cooperative nodes with untrustworthy decisions.

IV. Simulation Results

The number of Parvnum, an ammeter, for example, Pfa, SNR, and the quantity of tests are used to equate single threshold strategy, double threshold strategy, and proposed double threshold strategy. The Pfa esteem is assumed to be 0.1, and the number of tests to be 500. The graph represents 1000 Monte Carlo simulations with an SNR ranging from 0 to -20 dB. The single-threshold recognition technique has a discovery esteem probability of around 0.2 for an SNR estimation of - 12 dB, as shown in Fig. 3. The single threshold strategy is preferable to the double threshold technique, which has a detection probability of 0.3. Our proposed double threshold procedure, on the other hand, yields a 0.55 estimation, which is significantly better than the usual double threshold technique.

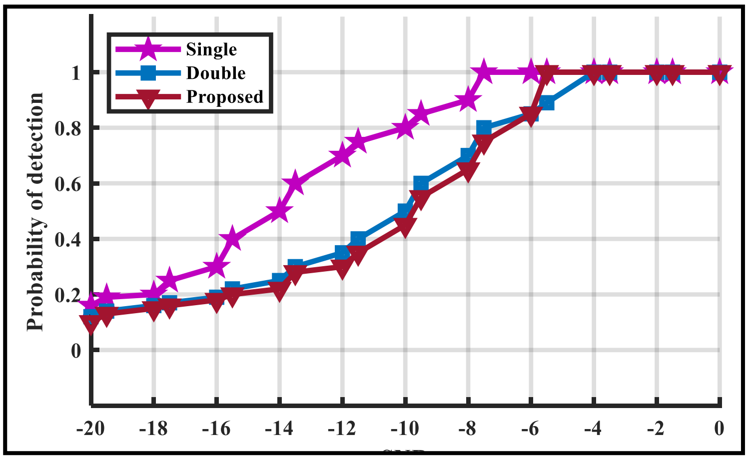

Fig. 3. Comparison of single, double, proposed double threshold method

The average number of samples required by the strategy suggested in this paper is depicted in Fig. 4.

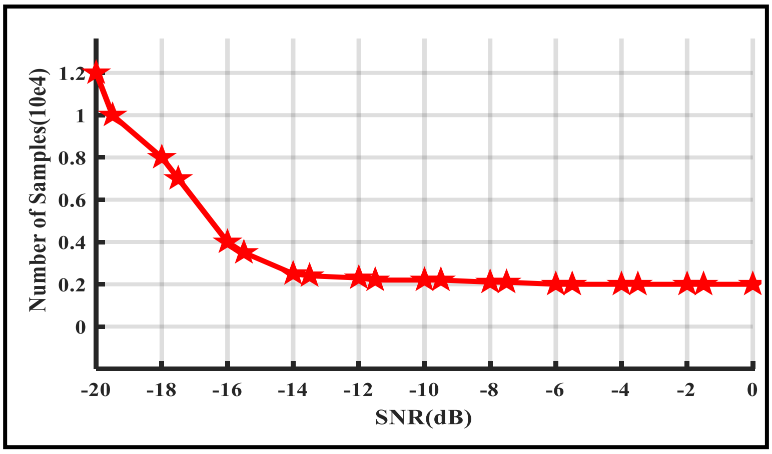

Fig. 4. Optimum numbers of samples versus SNR.

Fig. 5 indicates that SNR increases with the increasing of probability, and when P1 reaches to 0.5, the sampling number can be low enough by picking the suitable double thresholds however, the increasing the value of P1 may degrade the sensed performance of cooperative detection because of the increasing of Pf and Pm.

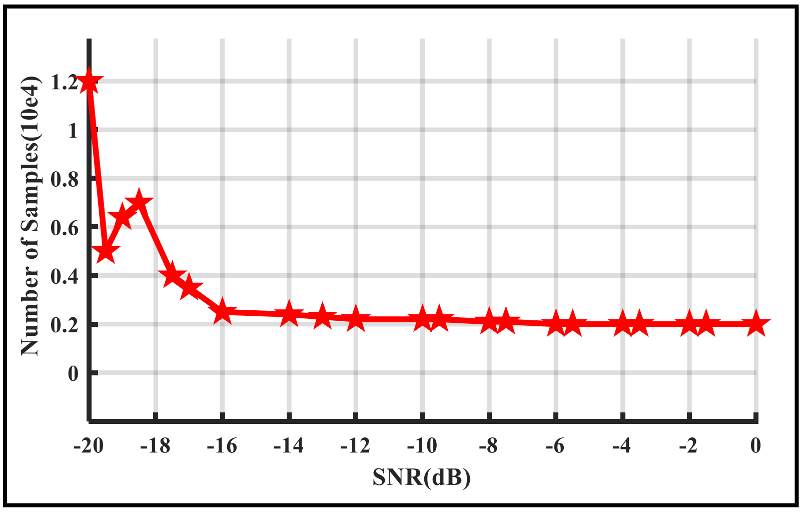

Fig. 5. SNR vs Probability of detection

The below table shows how the probability varies with change in SNR.

Table. 1. Comparison of probability detection

SNR Values	0.02	0.03	0.04	0.05
-20	1.0000	2.0000	2.000	2.000
-18	0.5000	0.5000	1.000	1.000
-16	0.2222	0.1818	0.2857	0.2857
-14	0.1429	0.1533	0.1538	0.1538
-12	0.1053	0.1333	0.1176	0.1176
-10	0.0769	0.0870	0.0870	0.0800
-8	0.0667	0.0833	0.0769	0.0667
-6	0.0588	0.0741	0.0714	0.0588
-4	0.0541	0.0645	0.0625	0.0571
-2	0.0526	0.0541	0.0526	0.0513
0	0.0513	0.0500	0.0488	0.0488

V. Conclusion

The two methodologies are the only threshold detection technique and therefore the double threshold detection technique. The normal method of obtaining energy features a number of disadvantages. To get over these restrictions, a two-step threshold detection strategy has been developed. The proposed unique dual threshold strategy outperforms the two existing strategies, namely the single threshold and double threshold methods. The techniques are evaluated using parameters including SNR, chance of detection, and sample count. Double threshold detection approaches outperform single threshold detection methods for various SNR values between 0 and -20 dB, according to simulations.

After spectrum sensing there is need of spectrum allocation which will actually delivers the data to users. Spectrum allocation in the proposed work. The double-threshold energy detection technique can effectively reduce the collision probability between the cognitive user and the primary user, as well as the cognitive user's interference with the primary user.

References

1. Ridouani, Mohammed, et al.,"A novel secure cooperative cognitive radio network based on Chebyshev map." Digital Signal Processing 126 (2022): 103482
2. Dr. S. Selvakanmani, Mr. Rajeev Ratna Vallabhuni, Ms. B. Usha Rani, Ms. A. Praneetha, Dr. Urlam Devee Prasan, Dr. Gali Nageswara Rao, Ms. Keerthika. K, Dr. Tarun Kumar, Dr. R. Senthil Kumaran, Mr. Prabakaran.D, "A Novel Global Secure Management System with Smart Card for IoT and Cloud Computing," The Patent Office Journal No. 06/2021, India. International classification: H04L29/08. Application No. 202141000635 A.
3. Nalajala Lakshman Pratap, Rajeev Ratna Vallabhuni, K. Ramesh Babu, K. Sravani, Bhagyanagar Krishna Kumar, Angothu Srikanth, Pijush Dutta, Swarajya Lakshmi V Papineni, Nupur Biswas, K.V.S.N.Sai Krishna Mohan, "A Novel Method of Effective Sentiment Analysis System by Improved Relevance Vector Machine," Australian Patent AU 2020104414. 31 Dec. 2020
4. S.V.S Prasad, Chandra Shaker Pittala, V. Vijay, and Rajeev Ratna Vallabhuni, "Complex Filter Design for Bluetooth Receiver Application," In 2021 6th International Conference on Communication and Electronics Systems (ICCES), Coimbatore, India, July 8-10, 2021, pp. 442-446.
5. Chandra Shaker Pittala, J. Sravana, G. Ajitha, P. Saritha, Mohammad Khadir, V. Vijay, S. China Venkateswarlu, Rajeev Ratna Vallabhuni, "Novel Methodology to Validate DUTs Using Single Access Structure," 5th International Conference on Electronics, Materials Engineering and Nano-Technology (IEMENTech 2021), Kolkata, India, September 24-25, 2021, pp. 1-5.
6. V. Siva Nagaraju, Rapaka Anusha, and Rajeev Ratna Vallabhuni, "A Hybrid PAPR Reduction Technique in OFDM Systems," 2020 IEEE International Women in Engineering (WIE) Conference on Electrical and Computer Engineering (WIECON-ECE), Bhubaneswar, India, 26-27 Dec. 2020, pp. 364-367.
7. V. Siva Nagaraju, P. Ashok babu, B. Sadgurbabu, and Rajeev Ratna Vallabhuni, "Design and Implementation of Low power FinFET based Compressor," 2021 3rd International Conference on Signal Processing and Communication (ICPSC), Coimbatore, India, 13-14 May 2021, pp. 532-536.
8. P. Ashok Babu, V. Siva Nagaraju, and Rajeev Ratna Vallabhuni, "Speech Emotion Recognition System With Librosa," 2021 10th IEEE International Conference on Communication

Systems and Network Technologies (CSNT), Bhopal, India, 18-19 June 2021, pp. 421-424.
9. P. Ashok Babu, V. Siva Nagaraju, and Rajeev Ratna Vallabhuni, "8-Bit Carry Look Ahead Adder Using MGDI Technique," IoT and Analytics for Sensor Networks, Springer, Singapore, 2022, pp. 243-253.
10. Chandra Shaker Pittala, M. Lavanya, V. Vijay, Y.V.J.C. Reddy, S. China Venkateswarlu, Rajeev Ratna Vallabhuni, "Energy Efficient Decoder Circuit Using Source Biasing Technique in CNTFET Technology," 2021 Devices for Integrated Circuit (DevIC), Kalyani, India, May 19-20, 2021, pp. 610-615.
11. Chandra Shaker Pittala, M. Lavanya, M. Saritha, V. Vijay, S. China Venkateswarlu, Rajeev Ratna Vallabhuni, "Biasing Techniques: Validation of 3 to 8 Decoder Modules Using 18nm FinFET Nodes," 2021 2nd International Conference for Emerging Technology (INCET), Belagavi, India, May 21–23, 2021, pp. 1-4.
12. P. Ashok Babu, V. Siva Nagaraju, Ramya Mariserla, and Rajeev Ratna Vallabhuni, "Realization of 8 x 4 Barrel shifter with 4-bit binary to Gray converter using FinFET for Low Power Digital Applications," Journal of Physics: Conference Series, vol. 1714, no. 1, p. 012028. IOP Publishing. doi:10.1088/1742-6596/1714/1/012028
13. Vallabhuni Vijay, C. V. Sai Kumar Reddy, Chandra Shaker Pittala, Rajeev Ratna Vallabhuni, M. Saritha, M. Lavanya, S. China Venkateswarlu and M. Sreevani, "ECG Performance Validation Using Operational Transconductance Amplifier with Bias Current," International Journal of System Assurance Engineering and Management, vol. 12, iss. 6, 2021, pp. 1173-1179.
14. Vallabhuni, Rajeev Ratna, M. Saritha, Sruthi Chikkapally, Vallabhuni Vijay, Chandra Shaker Pittala, and Sadulla Shaik, "Universal Shift Register Designed at Low Supply Voltages in 15 nm CNTFET Using Multiplexer," In International Conference on Emerging Applications of Information Technology, pp. 597-605. Springer, Singapore, 2021.
15. B. M. S. Rani, Vallabhuni Rajeev Ratna, V. Prasanna Srinivasan, S. Thenmalar, and R. Kanimozhi, "Disease prediction based retinal segmentation using bi-directional ConvLSTMU-Net," Journal of Ambient Intelligence and Humanized Computing, 2021, pp. 1-10. https://doi.org/10.1007/s12652-021-03017-y
16. Rajeev Ratna Vallabhuni, A. Karthik, CH. V. Sai Kumar, B. Varun, P. Veerendra, and Srisailam Nayak, "Comparative Analysis of 8-Bit Manchester Carry Chain Adder Using FinFET at 18nm Technology," 2020 3rd International Conference on Intelligent Sustainable Systems (ICISS), Thoothukudi, India, 2020, pp. 1579-1583, doi: 10.1109/ICISS49785.2020.9316061.
17. R. R. Vallabhuni, P. Shruthi, G. Kavya and S. Siri Chandana, "6Transistor SRAM Cell designed using 18nm FinFET Technology," 2020 3rd International Conference on Intelligent Sustainable Systems (ICISS), Thoothukudi, India, 2020, pp. 1584-1589, doi: 10.1109/ICISS49785.2020.9315929.
18. Rajeev Ratna Vallabhuni, J. Sravana, M. Saikumar, M. Sai Sriharsha, and D. Roja Rani, "An advanced computing architecture for binary to thermometer decoder using 18nm FinFET," 2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT), Tirunelveli, India, 20-22 August, 2020, pp. 510–515.
19. Rajeev Ratna Vallabhuni, K.C. Koteswaramma, B. Sadgurbabu, and Gowthamireddy A, "Comparative Validation of SRAM Cells Designed using 18nm FinFET for Memory Storing Applications," Proceedings of the 2nd International Conference on IoT, Social, Mobile, Analytics & Cloud in Computational Vision & Bio-Engineering (ISMAC-CVB 2020), 2020, pp. 1-10.
20. Rajeev Ratna Vallabhuni, Jujavarapu Sravana, Chandra Shaker Pittala, Mikkili Divya, B.M.S.Rani, and Vallabhuni Vijcaay, "Universal Shift Register Designed at Low Supply Voltages in 20nm FinFET Using Multiplexer," In Intelligent Sustainable Systems, pp. 203-212. Springer, Singapore, 2022.
21. P. Chandra Shaker, V. Parameswaran, M. Srikanth, V. Vijay, V. Siva Nagaraju, S.C. Venkateswarlu, Sadulla Shaik, and Vallabhuni Rajeev Ratna, "Realization and Comparative analysis of Thermometer code based 4-Bit Encoder using 18nm FinFET Technology for Analog to Digital Converters," In: Reddy V.S., Prasad V.K., Wang J., Reddy K.T.V. (eds) Soft Computing and Signal Processing. Advances in Intelligent Systems and Computing, vol 1325. Springer, Singapore. https://doi.org/10.1007/978-981-33-6912-2_50
22. Rajeev Ratna Vallabhuni, G. Yamini, T. Vinitha, and S. Sanath Reddy, "Performance analysis: D-Latch modules designed using 18nm FinFET Technology," 2020 International Conference on Smart Electronics and Communication (ICOSEC), Tholurpatti, India, 10-12, September 2020, pp. 1171–1176.
23. Vijay, Vallabhuni, Kancharapu Chaitanya, Chandra Shaker Pittala, S. Susri Susmitha, J. Tanusha, S. China Venkateshwarlu, and Rajeev Ratna Vallabhuni, "Physically Unclonable Functions Using Two-Level Finite State Machine," Journal of VLSI circuits and systems, vol. 4, no. 01, 2022, pp. 33-41.
24. Vijay, Vallabhuni, M. Sreevani, E. Mani Rekha, K. Moses, Chandra S. Pittala, KA Sadulla Shaik, C. Koteshwaramma, R. Jashwanth Sai, and Rajeev R. Vallabhuni, "A Review On N-Bit Ripple-Carry Adder, Carry-Select Adder And Carry-Skip Adder," Journal of VLSI circuits and systems, vol. 4, no. 01, 2022, pp. 27-32.

25. Vijay, Vallabhuni, Chandra S. Pittala, A. Usha Rani, Sadulla Shaik, M. V. Saranya, B. Vinod Kumar, RES Praveen Kumar, and Rajeev R. Vallabhuni, "Implementation of Fundamental Modules Using Quantum Dot Cellular Automata," Journal of VLSI circuits and systems, vol. 4, no. 01, 2022, pp. 12-19.
26. Vijay, Vallabhuni, Chandra S. Pittala, K. C. Koteshwaramma, A. Sadulla Shaik, Kancharapu Chaitanya, Shiva G. Birru, Soma R. Medapalli, and Varun R. Thoranala, "Design of Unbalanced Ternary Logic Gates and Arithmetic Circuits," Journal of VLSI circuits and systems, vol. 4, no. 01, 2022, pp. 20-26.
27. Chandra Shaker Pittala, Rajeev Ratna Vallabhuni, Vallabhuni Vijay, Usha Rani Anam, Kancharapu Chaitanya, "Numerical analysis of various plasmonic MIM/MDM slot waveguide structures," International Journal of System Assurance Engineering and Management, 2022.
28. M. Saritha, M. Lavanya, G. Ajitha, Mulinti Narendra Reddy, P. Annapurna, M. Sreevani, S. Swathi, S. Sushma, Vallabhuni Vijay, "A VLSI design of clock gated technique based ADC lock-in amplifier," International Journal of System Assurance Engineering and Management, 2022, pp. 1-8. https://doi.org/10.1007/s13198-022-01747-6
29. Chandra Shaker Pittala, Vallabhuni Vijay, B. Naresh Kumar Reddy, "1-Bit FinFET Carry Cells for Low Voltage High-Speed Digital Signal Processing Applications," Silicon, 2022. https://doi.org/10.1007/s12633-022-02016-8.
30. Vallabhuni Vijay, Kancharapu Chaitanya, T. Sai Jaideep, D. Radha Krishna Koushik, B. Sai Venumadhav, Rajeev Ratna Vallabhuni, "Design of Optimum Multiplexer In Quantum-Dot Cellular Automata," International Conference on Innovative Computing, Intelligent Communication and Smart Electrical systems (ICSES -2021), Chennai, India, September 24-25, 2021.
31. S. China Venkateswarlu, N. Uday Kumar, D. Veeraswamy, and Vallabhuni Vijay, "Speech Intelligibility Quality in Telugu Speech Patterns Using a Wavelet-Based Hybrid Threshold Transform Method," International Conference on Intelligent Systems & Sustainable Computing (ICISSC 2021), Hyderabad, India, September 24-25, 2021.
32. Rani, B.M.S, Divyasree Mikkili, Rajeev Ratna Vallabhuni, Chandra Shaker Pittala, Vijay Vallabhuni, Suneetha Bobbillapati, and Bhavani Naga Prasanna, H., "Retinal Vascular Disease Detection from Retinal Fundus Images Using Machine Learning," Australian Patent AU 2020101450. 12 Aug. 2020.
33. Rajeev Ratna Vallabhuni, D.V.L. Sravya, M. Sree Shalini, and G. Uma Maheshwararao, "Design of Comparator using 18nm FinFET Technology for Analog to Digital Converters," 2020 7th International Conference on Smart Structures and Systems (ICSSS), Chennai, India, 23-24 july, 2020, pp. 318-323.
34. Vallabhuni Rajeev Ratna, M. Saritha, Saipreethi. N, V. Vijay, P. Chandra Shaker, M. Divya, and Shaik Sadulla, "High Speed Energy Efficient Multiplier Using 20nm FinFET Technology," Proceedings of the International Conference on IoT Based Control Networks and Intelligent Systems (ICICNIS 2020), Palai, India, December 10-11, 2020, pp. 434-443. Available at SSRN: https://ssrn.com/abstract=3769235 or http://dx.doi.org/10.2139/ssrn.3769235
35. Rajeev Ratna Vallabhuni, S. Lakshmanachari, G. Avanthi, and Vallabhuni Vijay, "Smart Cart Shopping System with an RFID Interface for Human Assistance," 2020 3rd International Conference on Intelligent Sustainable Systems (ICISS), Thoothukudi, India, 2020, pp. 165-169, doi: 10.1109/ICISS49785.2020.9316102.
36. Saritha, M., Kancharapu Chaitanya, Vallabhuni Vijay, Adam Aishwarya, Hasmitha Yadav, and G. Durga Prasad, "Adaptive And Recursive Vedic Karatsuba Multiplier Using Non Linear Carry Select Adder," Journal of VLSI circuits and systems, vol. 4, no. 2, 2022, pp. 22-29.
37. Ch. Srivalli, S. Niranjan reddy, V. Vijay, J. Pratibha, "Low power based optimal design for FPGA implemented VMFU with equipped SPST technique," National Conference on Emerging Trends in Engineering Application (NCETEA-2011), India, June 18, 2011, pp. 224-227.
38. S. China Venkateswarlu, Ch. Sashi Kiran, R.V. Santhosh Nayan, Vijay Vallabhuni, P. Ashok Babu, V. Siva Nagaraju, "Artificial Intelligence Based Smart Home Automation System Using Internet of Things," The Patent Office Journal No. 09/2021, India. Application No. 202041057023 A.
39. Bandi Mary Sowbhagya Rani, Vasumathi Devi Majety, Chandra Shaker Pittala, Vallabhuni Vijay, Kanumalli Satya Sandeep, Siripuri Kiran, "Road Identification Through Efficient Edge Segmentation Based on Morphological Operations," Traitement du Signal, vol. 38, no. 5, Oct. 2021, pp. 1503-1508.
40. Ch. Srivalli, S. Niranjan reddy, V. Vijay, J. Pratibha, "Optimal design of VLSI implemented Viterbi decoding," National conference on Recent Advances in Communications & Energy Systems, (RACES-2011), Vadlamudi, India, December 5, 2011, pp. 67-71.
41. Katikala Hima Bindu, Sadulla Shaik, V. Vijay, "FINFET Technology in Biomedical-Cochlear Implant Application," International Web Conference on Innovations in Communication and Computing, ICICC '20, India, October 5, 2020.
42. V. Vijay, J. Prathiba, S. Niranjan Reddy, V. Raghavendra Rao, "Energy efficient CMOS Full-Adder Designed with TSMC 0.18μm Technology," International Conference on Technology and

Management (ICTM-2011), Hyderabad, India, June 8-10, 2011, pp. 356-361.

43. Vallabhuni Vijay, Pittala Chandra shekar, Shaik Sadulla, Putta Manoja, Rallabhandy Abhinaya, Merugu rachana, and Nakka nikhil, “Design and performance evaluation of energy efficient 8-bit ALU at ultra low supply voltages using FinFET with 20nm Technology,” VLSI Architecture for Signal, Speech, and Image Processing, edited by Durgesh Nandan, Basant Kumar Mohanty, Sanjeev Kumar, Rajeev Kumar Arya, CRC press, 2021.
44. Vallabhuni Vijay, and Avireni Srinivasulu, “A Novel Square Wave Generator Using Second Generation Differential Current Conveyor,” Arabian Journal for Science and Engineering, vol. 42, iss. 12, 2017, pp. 4983–4990.