Bharath
INSTITUTE OF HIGHER EDUCATION AND RESEARCH
(Declared as Deemed-to-be University under section 3 of UGC Act, 1956)
(Vide Notification No. F.9-5/2000 - U.3, Ministry of Human Resource Development, Govt. of India, dated 4th July 2002)
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173, Agaram Road, Selaiyur, Tambaram,
Chennai - 600 073. Tamil Nadu.

Ref No.SMS-2018-O-15

Date: 18/09/2020

BHARATH INSTITUTE OF HIGHER EDUCATION & RESEARCH (Declared as Deemed to be University U/S 3 of UGC Act 1956) 18 SEP 2020 OFFICE OF THE DEAN-RESEARCH Selaiyur, Chennai-600 073. INDIA

TO

Mrs. S. Arulselvi,

Associate Professor/ECE,

BIHER.

Thro: Concern Head of the Department

Greetings!!!

We are happy to announce that the Research Advisory Committee has approved your proposal for Seed Money Scheme-2018 which was presented by you. You are requested to complete the proposal and send the progress report to the Dean Research in the prescribed time period.

Title of the Project: Efficient Spectrum sensing using Cognitive radio networks

Seed Money Amount: Rs.1, 00,000/- (Rupees One Lakh Only)

Approved on: 10/03/2020

Payment details:

Cheque No.351643 **Dated: 16/09/2020**

Bank Name: Indian Bank, Selaiyur, Chennai.

With Regards

Dean-Research

इंडियन बैंक
Indian Bank

Branch : SELAIYUR (TAMBARAM)
PLOT NO 17 AND 18, HASAN COLONY
AGARAM ROAD, SELAIYUR.,TAMBARAM. CHENNAI T N.
IFS Code :IDIB000S246

10/04/2024
D D M M Y Y Y Y

PAY Ms. S. Arulselvi या धारक को OR BEARER

RUPEES रुपये One Lakh Only

अदा करें ₹ 1,00,000/-

खा.सं. A/c No.	CA 6670628110

FOR BIHER RESEARCH AND CONSULTANCY

CBS Code: 02505

AUTHORISED SIGNATORY

PAYABLE AT PAR AT ALL OUR BRANCHES

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⑈351643⑈ 600019250⑆ 628110⑈ 29

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PROPOSAL SUBMISSION

1. Details of Principal Investigator

Name : Dr.S.Arulselvi

Designation : Associate Professor

Highest Qualifications : Ph.D.

Department : Electronics and Communication Engineering

E-mail : arulselvi2003@gmail.com

Contact no : 8870334286

Date of Joining : 18.6.2008

2. Details of Co - Principal Investigator

Name : Dr.B.Karthik

Designation : Associate Professor

Highest Qualifications : Ph.D.

Department : Electronics and Communication Engineering

E-mail : karthikguru33@gmail.com

Contact no : 9842580740

Date of Joining : 07.09.2007

Technical details

1. Introduction

Cognitive radios have enabled the full utilization of the underutilized license spectrum by opportunistically transmitting without causing harmful interference to licensed users. With development of cognitive radios, there are many new security threats have been raised. As per Security threats concern as cognitive radio networks is a type of wireless network, it has all classic threats present in the conventional wireless networks. Apart from that have a main threat called Primary User Emulation Attack (PUEA) in the spectrum sensing process. To Overcome Spectrum scarcity and unused frequency band, new spectrum allocation policy called dynamic spectrum sharing is going to be used. This new policy would allow unused licensed spectrum bands called as white spaces to be used by unlicensed user called as secondary users (SUs). The success of this policy depends on the accuracy of the spectrum sensing that is used by the SUs to detect the spectrum hole. The cognitive radio technology act as the enabling technology for this dynamic spectrum sharing .Cognitive Radio (CR) enabled Dynamic Spectrum Access (DSA) networks are designed to detect and opportunistically utilize the unused or under-utilized spectrum bands.

2. Review of status of Research and Development in the subject

i) Attacks for spectrum sensing

Chen, Ruiliang, Jung-Min Park, and Jeffrey H. Defense against primary user emulation attacks in cognitive radio networks." IEEE Journal on selected areas in communications 26.1 (2008): 25-37.

Reed Detection of presence of PUEA is an important problem .PUEAs can be of two types:Greedy PUEA: Under which the attacker transmitting fake incumbent signals force all other users to vacate a specific band in order to acquire its exclusive use Malicious attack: Under which the attacker mimic incumbent signals in order to cause Denial of Service (DoS)

attacks. Furthermore, malicious attack could also cause DoS attacks to PU networks by creating harmful interference. There are many PUEA detection mechanisms in literature by R.Chen et al. He proposed a location based authentication scheme for the TV white spaces spectrum in which the location based RSSI database are formulated and the real time measured RSSI values are compared with these data base to detect the PUEA .

ii) Principle of cooperative sensing and fading channel performance analysis

C. Chen, H. Cheng, and Y.-D. Yao, "Cooperative spectrum sensing in cognitive radio networks in the presence of the primary user emulation attack," IEEE Trans. Wireless Commun., vol. 10, no. 7, pp. 2135–2141,Jul. 2011

The performance of hard information fusion (HIF) strategy for cooperative sensing will deteriorate CR user are not uniformly reliable. A novel virtual soft information fusion (VSIF) strategy is proposed which uses expectation for primary users (PU) presence probability to replace the local sensing decision of each user in the information fusion by WANG Ben et al.A weighted cooperative spectrum when cooperative sensing framework for infrastructure-based cognitive radio networks, to increase the spectrum sensing accuracy is presented by Yanxiao Zhao et al. In this, each cognitive radio performs local spectrum sensing and computes the total error probability which combines the false alarm probability and the missed detection probability. The total error probability and the energy signal from the primary user are then sent to the base station, the base station makes a final decision after combining the weighted energy signals from all cognitive radios.Gradient-based fully distributed cooperative spectrum sensing in cognitive radio is proposed for ad hoc networks. The licensed band used for TV transmission is considered for the primary user by Waleed Ejaz et al. A heterogeneous network consisting of primary radio network (PRN) and cognitive radio network (CRN) with underlay spectrum sharing is proposed by Sanjay Dhar Roya et al. The PRN and the CRN have separate BSs, and both networks are assumed to be multirate CDMA networks under this work. The CRN employs beam forming at the secondary BS (SBS) for the CR user of interest. Increasing the number of cognitive radio results the cooperation overhead and leads to a throughput degradation of the cognitive radio network. Throughput optimization of the hard fusion based sensing using the k-out-of-N rule is considered has proposed. Maximize the throughput of the cognitive radio network subject to the probability of detection and energy consumption per

cognitive radio in order to derive the optimal number of users. The optimal k and the best probability of false alarm are considered by Sina Maleki et al.Mobility driven power control framework for CR is proposed.

iii) **Cooperative sensing** by Unnikrishnan, Fan et al.

In Cooperative sensing technique, multiple CR users are incorporated for finding primary user. In this technique of primary transmitter detection there exist a hidden terminal problem, while having a good line-of-sight to receiver. CR transmitter could not able to find the primary transmitter due to shadowing as shown by Unnikrishnan,Fan et al. Cooperative sensing techniques are classified as

(1) Centralised Coordinated

(2) Decentralised Coordinated

(3) Decentralised Uncoordinated.

iv) Performance of an energy detector over channels with both multipath fading and shadowing by S.Attapattu et al.

In energy detection method, detection of the primary signal is based on energy of received signal by Attapattu. If previous knowledge of the PU signal is unidentified, the energy detection method is optimal for detecting any signals .In this approach, the radio-frequency (RF) energy in the channel or the received signal strength indicator is measured to find whether the channel is idle or not. In this method, the signal is given to the band pass filter to select channel and integrated over time interval. Finally the output of the integrator is compared with threshold to find whether the primary user is present or not. Based on the channel conditions the threshold value can set to be fixed or variable.

Disadvantages of the scheme are–

(1) The threshold utilized in energy selection depends on the noise variance.

(2) Inability to distinguish the interference from other secondary users sharing the same channel and the PU.

(3) It has poor performance under low SNR conditions. This is because of the noise variance is not accurately known at the low SNR, and the noise uncertainty may render the energy detection becomes useless.

2.1 International Status: NIL

2.2 National Status: NIL

3. Progress/achievement so far:

a) Reference papers were collected.

b) Literature survey was studied.

c) Proposal work has been started in the Energy detection based Spectrum sensing for Cognitive radio networks.

4. Work Plan:

4.1 Methodology:

The energy detector system consists of a wireless receiver which gives the digital version of the received signal, then the energy of the received signal is calculated. The calculated energy fed to the decision device. The decision device performs the decision of spectrum sensing and gives the output of whether the sensing spectral frequency is free or occupied by some primary user. There are many algorithms are proposed for the spectrum sensing in cooperative sensing. Among all these algorithms energy detector is the only one that is less computationally complex so it is adapted as one of the candidate in 802.22 standard of TV white space based RAN network. The received signal under AWGN is

$Y(n)=s(n)+n(n)$

s(n) is the transmitted signal ;n(n) is the additive Gaussian noise

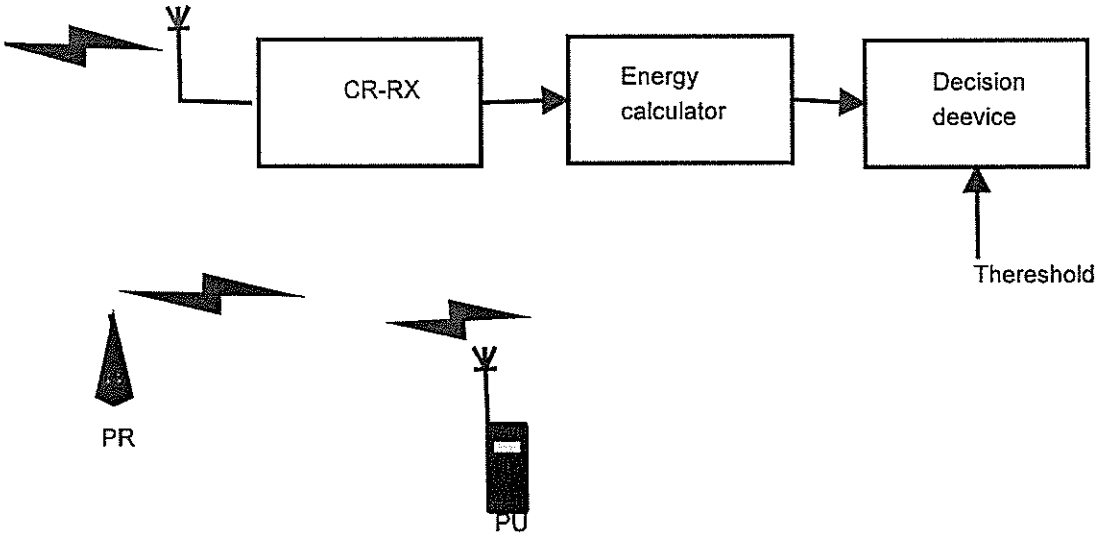
The output that comes out of the energy calculator is energy of the received signal over the time interval T and this output is considered as the test statistic to test the two hypotheses H0 and H1 by Arkoulis. H0: corresponds to the absence of the signal and presence of only noise. H1: corresponds to the presence of both signal and noise. Thus for the two state hypotheses numbers of important cases are

R1) H1 turns out to be TRUE in case of presence of primary user i.e. P (H1 / H1) is known as Probability of Detection (Pd).

R2) H0 turns out to be TRUE in case of presence of primary user i.e. P (H0 / H1) is known as Probability of Missed-Detection (Pm).

R3) H1 turns out to be TRUE in case of absence of primary user i.e. P (H1 / H0) is known as Probability of False Alarm (Pf).

Block Diagram:

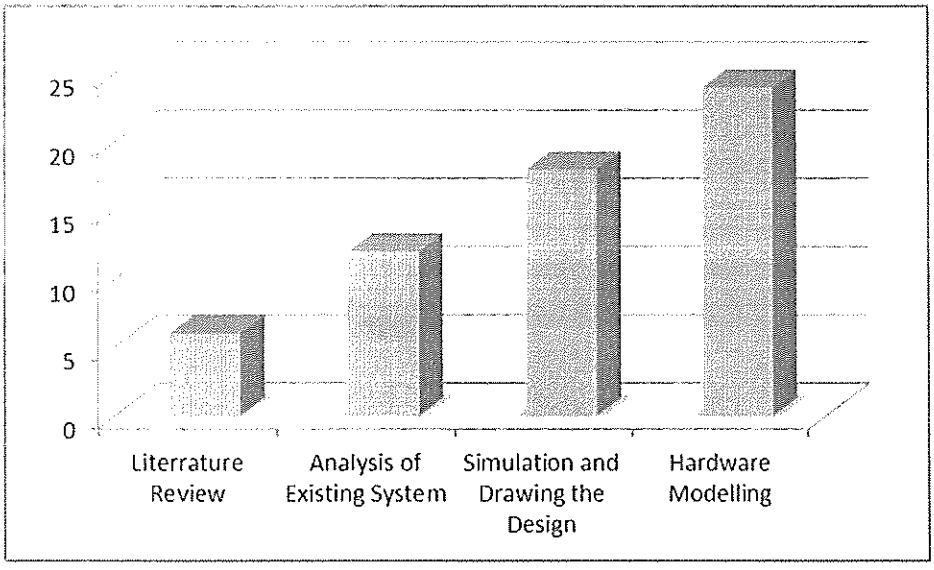


CR Energy detector system

4.2 Time Schedule of activities giving milestones through BAR diagram.

Work plan (including detailed methodology and time schedule)

Sl. No.	Activity / Milestone	1st Year		2nd Year	
1.	Literature review	1-6			
2.	Analysis of existing system		7-12		
3.	Simulation and Drawing the design			13-18	
4.	Hardware modelling				19-24



4.3 Expected outcome within the time period of Seed Money Scheme

Prototype Hardware design can be implemented within the time period of Seed Money Scheme.

5 Suggested Plan of action stating the name of funding agency where the project will be communicated for financial support within the time period of project. NIL

6 Bibliography:

[1] Arkoulis, S.; Kazatzopoulos, L.; Delakouridis, C.; Marias, G.F., "Cognitive Spectrum and Its Security Issues," *Next Generation Mobile Applications, Services and Technologies, 2008. NGMAST '08. The Second International Conference on* , vol., no., pp.565,570, 16-19 Sept. 2008.

[2] Wassim El-Hajj; Haider Safa; Mohsen Guizani, "Survey of Security issues in Cognitive Radio Network," journal of internet technology, volume 12 2011.

[3] Marcus, Michael J., "Unlicensed cognitive sharing of TV spectrum: the controversy at the Federal Communications Commission,"*Communications Magazine, IEEE* , vol.43, no.5, pp.24,25, May 2005.

[4] Liang, Ying-Chang, et al. "Cognitive radio networking and communications: An overview." *IEEE Transactions on Vehicular Technology* 60.7 (2011): 3386-3407.

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[7] Akyildiz, Ian F., et al. "NeXt generation/dynamic spectrum access/cognitive radio wireless networks: a survey." *Computer networks* 50.13 (2006): 2127-2159.

[8]Kaur, Prabhjot, Arun Khosla, and Moin Uddin Senior. "Markovian Queuing Model for Dynamic Spectrum Allocation in Centralized Architecturefor Cognitive Radios." *International Journal of Engineering and Technology* 3.1 (2011): 96.

[9]Yucek, Tevfik, and Huseyin Arslan. "A survey of spectrum sensing algorithms for cognitive radio applications." *IEEE communications surveys & tutorials* 11.1 (2009): 116-130.

[10] Atapattu, Saman, Chintha Tellambura, and Hai Jiang. "Energy detection based cooperative spectrum sensing in cognitive radio networks." *IEEE Transactions on Wireless Communications* 10.4 (2011): 1232-1241.

7 List of Projects submitted/implemented by the Investigators (Separate for Pi and Co-PI) Nil

7.1 Details of Projects submitted to various funding agencies:

Sl.No	Title	Cost in Lakhs	Month of Submission	Role as PI/Co PI	Agency	Status
1	NA	NA	NA	NA	NA	NA

7.2 Details of Projects under implementation

Sl.No	Title	Cost in Lakhs	Duration	Role as PI/Co PI	Agency
1	NA	NA	NA	NA	NA

7.3 Details of Projects completed during last 5 years

Sl.No	Title	Cost in Lakhs	Duration	Role as PI/Co PI	Agency
1	NA	NA	NA	NA	NA

8 List of publications published by the Investigators, if any:

a) Co - Principal Investigator

S.No	Author names	Title of paper	Name ofJournal	Vol (issue)	Page no.	Year
1.	Arulselvi, S. Karthik, B. Sundararajan, M,	Modeling and Simulation Capacity Analysis of MIMO Wireless Sensor Network	Journal Of Mechanics Of Continua And Mathematical Sciences	Special Issue, No.-2	236-245	2019
2.	Karthik, B. Jasmin, M. Arulselvi S.	Real Concern to High Speed VLSI Design for Interconnect Scaling	Journal Of Mechanics Of Continua And Mathematical Sciences	Special Issue, No.-2	457-463	2019
3.	Karthik, B. Philomina, S Jasmine	BIST for reconfigurable system on chip (SOC) for micro-vibration measurement	International Journal of Engineering and Advanced Technology	8(6)	67-70	2019
4.	Karthik, B. Sriram, M. Sidharth Raj, R.S.	Authentication of bi-level QR code with dynamic pattern generation	International Journal of Engineering and Advanced Technology,	8(6)	346-350	2019
5.	Karthik, B., MeenaKumari, G., Jasmin, M., Arulselvi, S.,	Intermittently associated mobile cognitive radio networks using portability assisted routing	International Journal of Engineering and Advanced Technology	8(Special Issue 2)	71-74	2019
6.	GowriSankaran , B., Karthik, B., Vijayaragavan, S.P.,	Entropy based estimation algorithm using break-up images to decrease loss compression ratio.	International Journal of Recent Technology and Engineering	8(2)	4700-4703	2019
7.	Vaidianathan, B., Arul Selvi,	A stochastic analysis on translating Nam speech into	International Journal of		839-	

	S., Karthik, B	normal speech, International Journal of Recent Technology and Engineering	Applied Engineering Research	7(5)	842	2019
8.	Manik, K.R., Arulselvi, S.,Karthik, B.	Granular traffic analysis and energy modeling in NoC with enhanced data transmission	International Journal of Innovative Technology and Exploring Engineering	8(5)	352-362	2019
9.	Manik, K.R., Arulselvi, S.,Karthik, B.	Designing network interface component for peripheral IP cores in networks-on-chip	International Journal of Innovative Technology and Exploring Engineering	8(4)	329-336	2019
10.	Karthik, B., Sundararajan, M	Integer wavelet transform utilized SVC-H.264 standard for medical video compression,	Journal of Chemical and Pharmaceutical Sciences	9(3)	S266-S269	2016
11.	Karthik, B., Susila, M., Sundararajan, M.,	Talking navigation cane with moveable braille note taker for visually impaired, , V-9, I-3, pp-S279-S282, 2016.	Journal of Chemical and Pharmaceutical Sciences	9(3)	S279-S282	2016
12.	Thamarai, P., Karthik, B.,	Effect of feature fusion for PF tumor segmentation with modified ams algorithm	Middle - East Journal of Scientific Research	20(12)	2245-2251	2014
13.	Philomina, S., Karthik, B.,	Wi-Fi energy meter implementation using embedded linux in ARM	Middle - East Journal of Scientific Research	20(12)	2434-2438	2014
14.	Karthik, B., Arulselvi, Selvaraj, A.,	Test data compression architecture for lowpowervlsi	Middle - East Journal of Scientific	20(12)	2331-2334	2014

		testing	Research			
15.	Karthik, B., Kumar, T.V.U.K.,	Authentication verification and remote digital signing based on embedded arm (LPC2378) platform	World Applied Sciences Journal	29(9)	1170-1174	2014
16.	Dolphin Kiruba, D., Karthik, B.,	Development of period extension and randomness using RM-PRNG. , V-9, I-22, pp-6194-6201, 2014.	International Journal of Applied Engineering Research	9(22)	6194-6201	2014
17.	Nirosha, R., Karthik.B	Increasing the system efficiency using contactless power transfer system	International Journal of Applied Engineering Research	9(22)	6456-6462	2014
18.	Kiran Kumar, T.V.U., Karthik, B., Bharath Kumaran, E.,	Implementation of a can-based digital driving system for a vehicle, V-13, I-12, pp-1564-1569, 2013	Middle - East Journal of Scientific Research	13(12)	1564-1569	2013
19.	Karthik, B., Kiran Kumar, T.V.U., Vijayaragavan, P., Bharath Kumaran, E,	Design of a digital PLL using 0.35µm CMOS technology	Middle - East Journal of Scientific Research	18(12)	1803-1806	2013
20.	Karthik, B., Kiran Kumar, T.V.U., Bharath Kumaran, E,	Visual secret sharing scheme for JPEG compressed images	Middle - East Journal of Scientific Research	12(12)	1873-1880	2012

b) Principal Investigator

S. No	Author names	Title of paper	Name of Journal	Vol (issue)	Page no.	Year
1.	Dr. Prasanna, Dr.S Arulselvi	Collaborative Configurations Of Wireless Sensor Networks System	International Journal of Pure and Applied Mathematics	116(15)	1311-8080	2016
2.	Dr. S Arulselvi, Dr. M Sundararajan	A Framework For Road Network Extraction From Remotely Sensed High Resolution Image	Journal of Chemical and Pharmaceutical Sciences	9(3)	136-144	2015
3.	Dr. S Arulselvi, Dr. M Sundararajan	Enhancement And Mobilization Of Transportation System Using Secured Operating Systems	Journal of Chemical and Pharmaceutical Sciences	9(3)	145-148	2015
4.	S.Arulselvi, Dr.T.V.U.Kiran kumar	Location Based Spectrum Sensing For Rayleigh Fading	International Journal of Innovative Science Engineering and Technology	2(3)	778-782	2015
5.	S.Arulselvi	Higher Order Statics based Primary user Emulation Attack Detection	Indian Journal of Science and Technology	8(32)	144-149	2015
6.	Vaishnavi.S, Karthik.B Arulselvi.S	De Noising Of Medical Images By Using Wavelet and Gaussian Laplacian Models.	International Journal Of Engineering Sciences & Research Technology,	4(4)	6981-6989	2015
7.	S.Arulselvi Dr.M.Sundararajan	A Combined Framework for Routing and Channel Allocation for Dynamic Spectrum Sharing using Cognitive Radio	International Journal of Applied Engineering Research	11	4951-4953	2016

8.	S.Arulselvi, Jasmine	Improved neighbouring coverage and Broadcasting system	International Journal of Pure and Applied Mathematics.	116	251-254	2016
9.	S.Arulselvi, Dr.M.Sundararajan	SVM based Two Level Authentication for Primary User Emulation Attack detection	Indian Journal of Science and Technology	9(29)	1759–1766	2016
10.	S. Saravana, S.Arulselvi	Adaboost SVM based brain tumour image segmentation and classification	International Journal of Pure and Applied Mathematics	116	399-404	2017
11.	Arulselvi, S. Karthik, B. Sundararajan, M,	Modeling and Simulation Capacity Analysis of MIMO Wireless Sensor Network	Journal Of Mechanics Of Continua And Mathematical Sciences	Special Issue, No.-2	236-245	2019
12.	Karthik, B., Arulselvi, Selvaraj, A.,	Test data compression architecture for lowpowervlsi testing	Middle - East Journal of Scientific Research	20(12)	2331-2334	2014
13.	Manik, K.R., Arulselvi, S.,Karthik, B.	Designing network interface component for peripheral IP cores in networks-on-chip	International Journal of Innovative Technology and Exploring Engineering	8(4)	329-336	2019
14.	Vaidianathan, B., Arul Selvi, S., Karthik, B	A stochastic analysis on translating Nam speech into normal speech, International Journal of Recent Technology and Engineering	International Journal of Applied Engineering Research	7(5)	839-842	2019
15.	Manik, K.R., Arulselvi, S.,Karthik, B.	Granular traffic analysis and energy modeling in NoC with enhanced data transmission	International Journal of Innovative Technology and	8(5)	352-362	2019

			Exploring Engineering			
16.	Karthik, B., MeenaKumari, G., Jasmin, M., Arulselvi, S.,	Intermittently associated mobile cognitive radio networks using portability assisted routing	International Journal of Engineering and Advanced Technology	8(Special Issue 2)	71-74	2019
17.	Karthik, B. Jasmin, M. Arulselvi S.	Real Concern to High Speed VLSI Design for Interconnect Scaling	Journal Of Mechanics Of Continua And Mathematical Sciences	Special Issue, No.-2	457-463	2019

9. Budget

SI. No.	Equipment	Quantity	Amount in INR
1	TMS320C6713 DSK signal processing kit	1	59,395
2	Consumables (Like, testing tools Charge controller, etc.)	As per requirement	25,000
3	Travel support for the purpose of research work.	---	5,605
4	Contingency	---	5000
5	Others	---	5000
	Total		1,00,000

10. Name of at least two subject experts from the Institute and one from the outside Institute with their contact details:

a) Dr.M.Sundararajan– Professor, Dept of ECE, BIHER, Chennai-600073.

b) Dr.Ravikumar – Associate Professor, Dept of ECE, VELS institute of Science and Technology & Advanced studies, Chennai.

CERTIFICATE FROM THE INVESTIGATOR

Project Title: Effective spectrum sensing using Cognitive radio networks

It is certified that

1. I do hereby agree to submit a complete proposal for financial support to the external funding agency within the time period of SMS-2018

2. I undertake that spare time on equipment procured in the project will be made available to other users.

3. I agree to submit a certificate from Institutional Biosafety Committee, if the project involves the utilization of genetically engineered organisms. I also declare that while conducting experiments, the Biosafety Guidelines of Department of Biotechnology, Department of Health Research, GOI would be followed in to.

4. I agree to submit ethical clearance certificate from the concerned ethical committee, if the project involves field trails/experiments/exchange of specimens, human & animal materials etc.

5. I agree to abide by the terms and conditions of SMS-2018, BIHER, and Chennai.

Name and signature of
Principal Investigator
Dr. S. Arulselvi

Name and signature of
Co-Principal Investigator
Dr. R. Karthik

Date: 06.01.2020
Place: Chennai - 73

Forwarded by Head of the Department

Signature of the Head

PROJECT EVALUATION FORMAT

Recommendation Sheet

Name of the Principal Investigator	Dr.S.Arulselvi
Name of the Co-Investigator	Dr.B.Karthik
Name of the Department	ECE
Title of project	Efficient Spectrum sensing using Cognitive radio networks
Recommendation of the evaluation committee	— Recommended —
Financial allocation recommended	Rs. 1,00,000 —

SI. No.	Equipment	Quantity	Amount in INR
1	TMS320C6713 DSK signal processing kit	1	59,395
2	Consumables (Like, testing tools Charge controller, etc.)	As per requirement	25,000
3	Travel support for the purpose of research work.	---	5,605
4	Contingency	---	5000
5	Others	---	5000
	Total		1,00,000

Name and Signature of the Research Advisory Committee members with date