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SRR Loaded Asymmetrical CPW Fed F Shaped Antenna for on-Body Telemetry Applications

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Abstract: SRR loaded asymmetric coplanar waveguide fed F shaped wearable antenna is proposed for medical telemetry applications. This antenna is very useful for wearable health monitoring during yoga, sports and other exercise. The proposed antenna can be tuned to resonate at resonance frequency of 1.43 GHz is obtained and this band is suitable for wireless medical telemetry services. The minimum value of Magnitude of Reflection Coefficient attains -42.99dB[a],-52.6dB[b],-15.79dB[c], and voltage standing wave ratios are 1.015[a], 1.0112[b], 1.387[c] at resonating frequency of 1.431GHz respectively.

Keywords: split ring resonator, medical telemetry services, Asymmetrical CPW, SRR loaded F shaped Antenna.

I. INTRODUCTION

The SRR loaded inverted F shaped patch antenna is enabled low-power, intelligent, miniature, low profile with high data-rate wireless medical telemetry communication. The main advantage of split ring resonator loaded antenna has enhanced the bandwidth and gain [11]. The proposed design using a buffer layer, which is located in between radiation element and skin layer, therefore the designed antenna has enabled to high gain. The concept of meta-material is introduced by sir Jagadish Chandra Bose from India. It is investigated by use of the Finite Difference Time domain design numerical codes and its simulation software CST microwave studio, its multilayered spherical dyadic green function are used for modelling of wearable antenna.

Recently many people are suffering disease like cancer, cardiovascular disease; Parkinson's disease, Bronchitis, obesity, diabetes and many more chronic or fatal diseases are reported in World Health Organization (WHO) [1, 11]. As people are increasingly suffering from medical problems treatment becomes more expensive than previous scenario. As world's population is growing exponentially the cost of health care monitoring is also increasing. The expected population growth by 2050 is double as compared to 2010. The cost of medicine increased day to day life. The effective wireless communication utilization reduced this current quandary. Recently new wireless and advanced electronics, telecommunication; satellite technology with printed circuit antenna has enabled to provide low-power, intelligent, miniature, low profile with high data rate wireless medical telemetry services.

In this paper organized as section II SRR loaded F shaped Wearable antenna works on WMTS band, wearable health monitoring during yoga, sports and other exercise and other biological aspects over a distance through radio frequency communication. Section III includes the explanation of the geometrical diagram of the proposed antenna. The section IV of this paper concentrates on the simulation results and descriptions. Section V is the conclusion part of the paper discussing future scope of on-body antenna in the field telemetric applications.

II. DESIGN METHODOLOGY FOR PROPOSED ANTENNA

The designed SRR loaded with asymmetrical coplanar wave guide is a quasi mode transmission line using in microwave integrated circuits and in fabricated antennas, as signal carrying element. Two identical ground plane and one middle metallic strip conductors are in the same plane. The effective dielectric constant and characteristic impedance of this line is given by [3, 4].

$$\varepsilon_{reff,sub} \cong 1 + y(\varepsilon_r - 1) \tag{1}$$

$$z_o \cong \frac{30\pi z}{\sqrt{\varepsilon_{reff,sub}}} \tag{2}$$

The letter y is called the filling fraction, the expression for m depends on the shape of geometry and z is elliptical integrals [5].

$$\varepsilon_{reff,sub} = \frac{\varepsilon_{r,b}+1}{2} + \frac{\varepsilon_{r,b}-1}{2}\left[1+12\frac{h}{w}\right] \tag{3}$$

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The equation (3) indicates effective dielectric constant of substrate. This proposed antenna used non biocompatible substrate-roger3210 with dielectric constant 10.6, thickness 1.6 mm, so as to resonate at 1.43GHz, then the width of single element of rectangular patch is given by[2,6,7],

$$W = \frac{c}{2f_{op}}\sqrt{\frac{2}{\varepsilon_{r,b}+1}} \quad (4)$$

From equation (4) width of antenna 33mm obtained. Finally the effective length of a SRR loaded proposed antenna is calculated analytically.

$$L_{eff} = \frac{c}{2f_{op}\sqrt{\varepsilon_{r,b}}} \quad (5)$$

From equation (5) the effective length of a SRR loaded proposed antenna is 35mm obtained.
The permittivity and permeability relationship between frequencies is given by.

$$\varepsilon_{b(\omega)} = \varepsilon_{ob}\left[1 - \frac{\omega_{pe,b}^2}{\omega_b(\omega_b - j\Gamma_{e,b})}\right] \quad (6)$$

$$\mu_{b(\omega)} = \mu_{ob}\left[1 - \frac{\omega_{pm,b}^2}{\omega_b(\omega_b - j\Gamma_{m,b})}\right] \quad (7)$$

The electric and magnetic current related to SRR structure is given by,

$$\frac{d(J_{ib,}D_{rude})}{dt} + \Gamma_{e,b} J_{ib,} D_{rude} = \varepsilon_{ob}\omega_{pe,b}^2 E_{ib} \quad (8)$$

III. SCHEMATIC REPRESENTATION OF PROPOSED ANTENNA.

The SRR loaded have enabled miniaturisation and low power consumption moreover electromagnetic wave manipulating capability (called as a backward wave) etc. due to this properties the SRR loaded antennas are mostly used in defence and medical field. The medical field it pulled out bio-information from a body and transmits a signal to an external wireless device. Circular shape split ring loaded structure used for antenna size reduction and frequency tuning, gain and bandwidth improvement. The proposed antenna used biocompatible Teflon substrate. The electrical characteristic of the tissue are, ϵ_r =51.65 at 1.43GHz, and conductivity is 0.93 (s/m) at 1.43GHz [5, 6, 9]. The geometry of the antenna and patch dimension is shown in Fig.1 and Table.1.

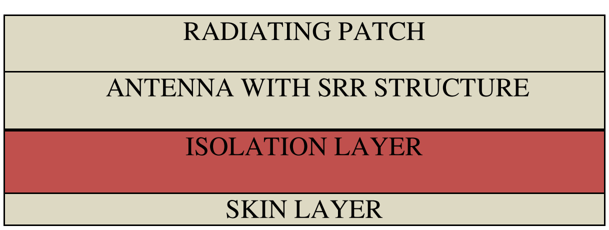

Fig.1.The layered view of proposed antenna.

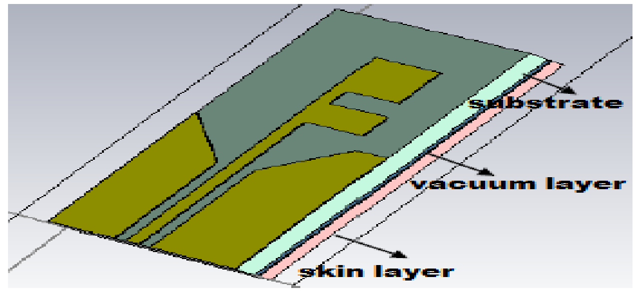

Fig.2.The proposed antenna layers.

Table.1. Dimension of a proposed structure.

Antenna dimension	Value(mm)
L	35
W	33
L_1	12.8
L_2	30
L_3	05
L_4	18
W_2	14.13
W_3	14.8
W_4	11.8
S	11.2
R_1	12
R_2	8
G_2	0.5
S_1	1
D	2

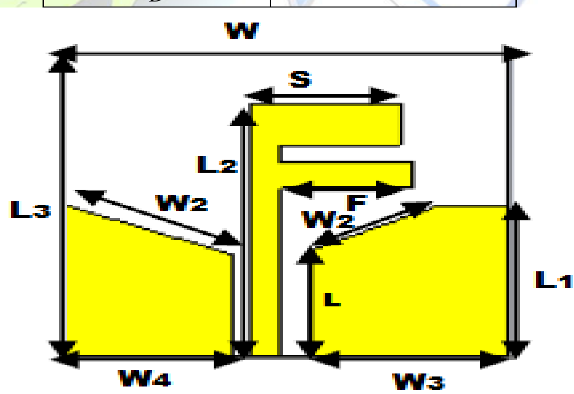

Fig.3.Geometrical representation of SRR loaded proposed F shape with trapped ground plane antenna.

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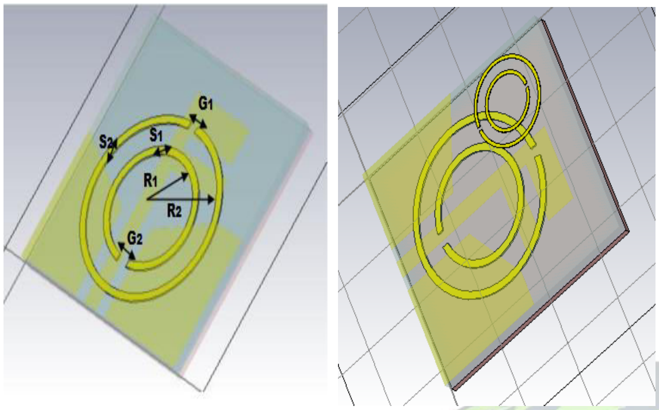

Fig.4. Geometrical representations[a]single SRR F shaped Antenna [b] double SRR (on bottom and top) of F shaped Antenna.

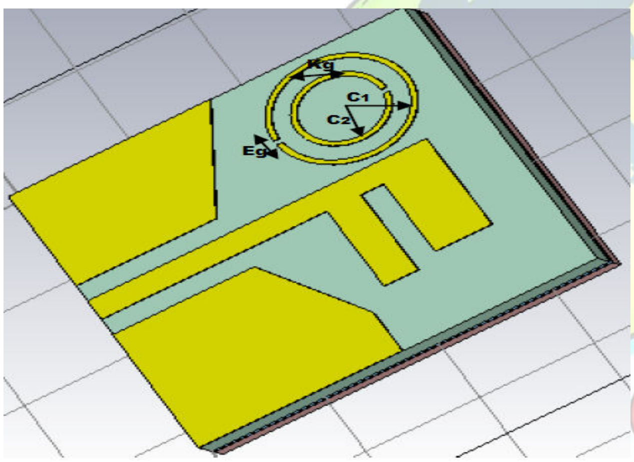

Fig.5. Geometrical representations single SRR loaded on the topside of F shaped Antenna.

IV.RESULTS AND DISCUSSION

The antenna is computer-generated while implement on body for wearable health monitoring during yoga. The premeditated antenna is implementing on the skin layer. Few antenna parametric results are discussed as give below.

A.MAGNITUDE OF REFLECTION COEFFICIENT

The give designed antennas resonate at a resonating frequency 1.431GHz. The Is_{11}I values are consist of 42.9dB[a],-52.6dB[b],-15.79dB[c], and -10dB band widths are (254[a], 262[b], 147[c]) MHz, respectively are shown in fig.6.

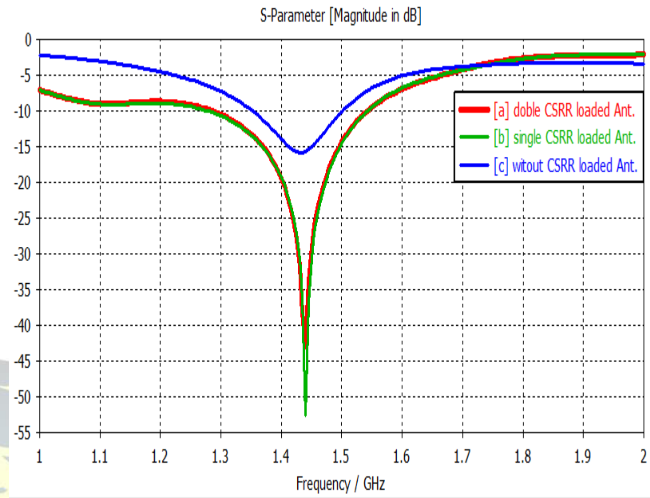

Fig.6.Magnitude of reflection coefficient versus frequency plot [a]double SRR loaded F antenna [b] single SRR loaded F antenna [c] without SRR.

B .VOTAGE STANDING WAVE RATIO

VSWR at the antenna input terminals are directly related to reflection coefficient, characteristic impedance and input impedance. VSWR values are 1.015[a], 1.0112[b], 1.387[c] for proposed antenna at 1.431GHz respectively.

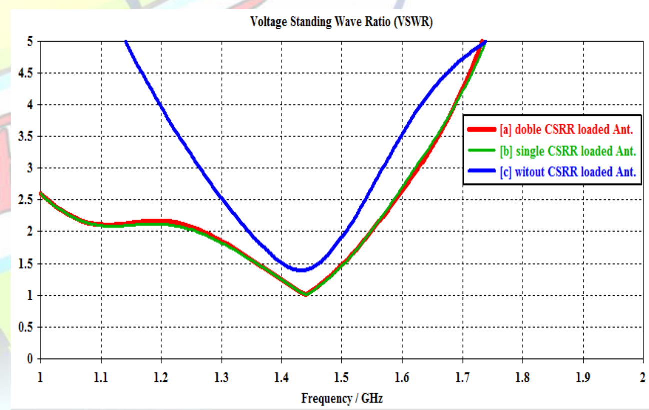

Fig.7.VSWR versus frequency plot [a]double SRR loaded F antenna [b] single SRR loaded F antenna [c] without SRR loaded F Antenna.

C.FAR FIELD GAIN

The some amount of radiated power is absorbed by human tissue. This absorption rate is called SAR value, due to this wearable antenna gain is reduced some amount. This absorption is related to the operating frequencies are shown in Fig.8, 9.

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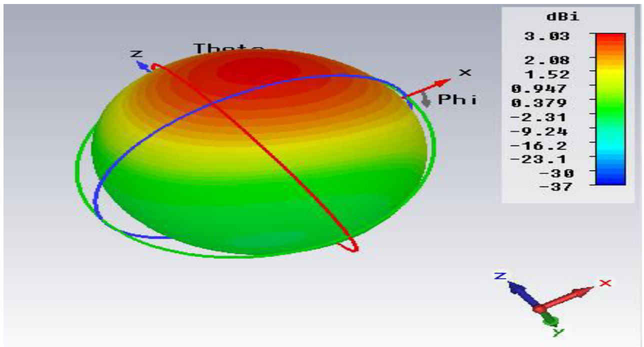

Fig.8.3D-plot of directive gain at 1.43GHz.

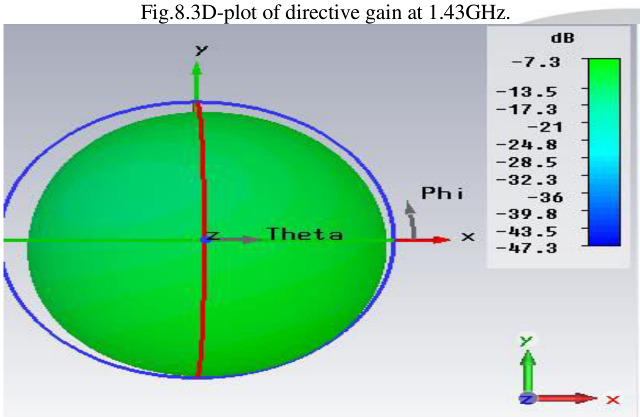

Fig.9.3D- plot of gain at 1.43GHz

D. RADIATION PATTERN

It is a graphical representation or mathematical representation of radiation characteristic at far field as function of time as well as spatial domain [8, 10,12].the radiation pattern of proposed antennas are shown in Fig.10-13.

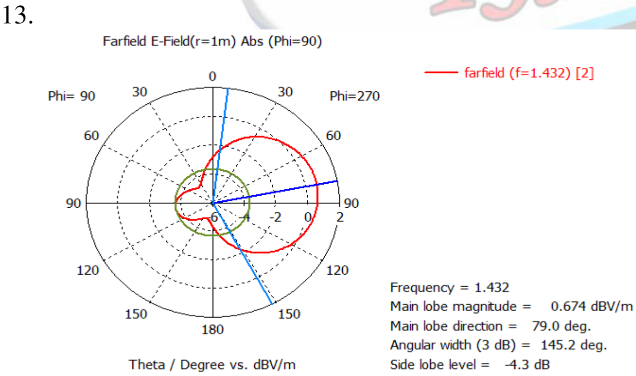

Fig.10.E-field of SRR loaded F shaped antenna at 1.43GHz.

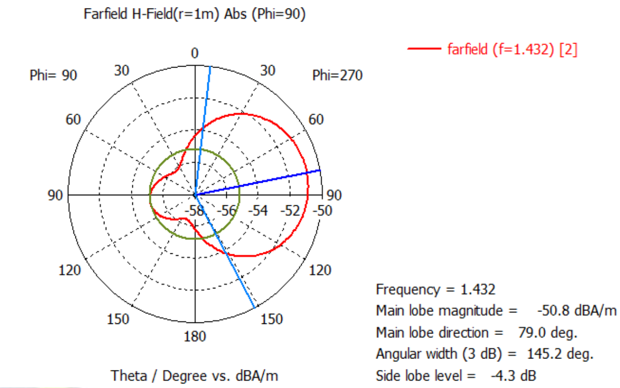

Fig.11. H-field of SRR loaded F shaped antenna at 1.43GHz.

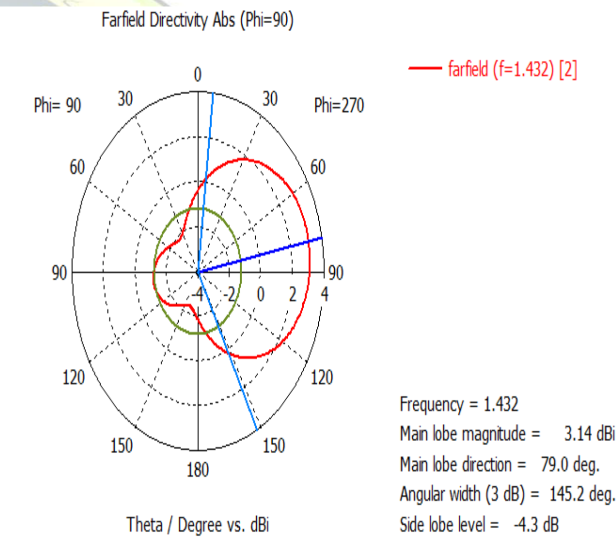

Fig.12. 3D- plot of directivity at 1.43GHz.

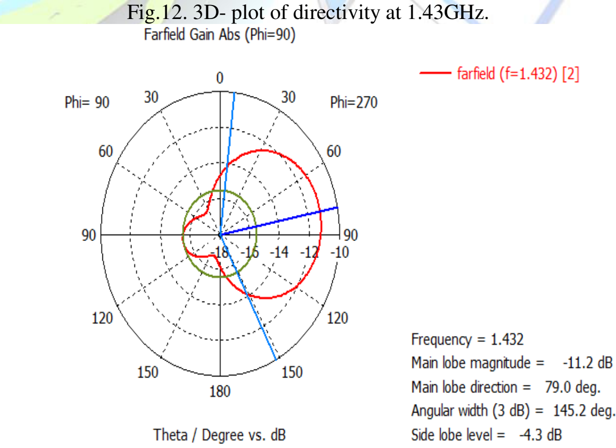

Fig.13. Shows polar plot of gain at 1.43GHz

Table 2.1 Comparisons between different wearable antennas.

Reference	Dimension[mm^3]	Gain[dB]	10dB-BW [MHz]	Dielectric Materials
[11]	15240	-16	12	ARLON1000
[4]	10240	-	20	Rogers3120
[6]	6480	-	20	RT/duroid6002
[11]	1265.6	-25	142	Rogers3120
Prop.Ant. [a]	1848	-7.3	254	Rogers6002
Prop.Ant. [b]	1848	-7.3	262	Rogers6002
Prop.Ant. [c]	1848	-11.2	147	Rogers6002

V.CONCULSION

The SRR asymmetrical CPW fed F shape wearable antenna is designed in this paper for medical telemetry applications. The designed antenna overall dimension is 35x33x1.6mm^3, and simulated results for the magnitude of reflection coefficient are -42.99dB[a],-52.6dB[b],-15.79dB[c] at 1.43GHz respectively.

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REFERENCES

[1] Samaneh Morassaghi, Mehran Abolhasan, Justin Lipman "Wireless body Area Networks: A Survey" *IEEE Communi. Surveys and tutorial Vol.16.No.3. Third quarter* 2014.

[2] S. Ashok Kumar, T. Shanmuganantham, J.Navin Sankar, "Design and Development of Implantable CPW fed Monopole L- Slot Antenna at 2.45 GHz ISM Band for Biomedical Applications", *International Journal for RF Technologies: Research and Applications*, vol.7, August 2016.

[3] T.Shanmuganantham, "Design and performance of implantable CPW fed Apollian Shaped Antenna at 2.45 ISM band for Bio-medical Applications" *transaction on electrical and electronic material,* vol.16, pp.250-253, October 2015.

[4] S.Ashok Kumar,T.Shanmuganantham "Design and analysis of implantable CPW fed bowtie antenna for ISM band applications" *Int.J . Electron. Commun. (AEU), Elsevierpublication,68(2014)158*

[5] S.Ashok Kumar,T.Shanmuganantham "design of clover slot antenna for biomedical application" *Alexandria Engg. Journal* 2016.

[6] S.Ashok Kumar,T.Shanmuganantham,M.Arun Raj " analysis and design of CPW fed antenna at ISM band for biomedical application"` *Alexandria Engg. Journal* 2017.

[7] Bose anundhimeena, P.T Selvan, S raghavan "compact metamaterial Antenna with high directivity for bio-medical systems" *circuits and systems,* 2016.

[8] S.A.Kumar,T.Shanmuganantham, R sanmuga sundaram, "CPW-fed small meta-material inspired antenna for WiMAX and WLAN applications" *IEEE Cof. on Indian ant. Week,* 2016.

[9] C.M Cynthia, Raghavan S "a flexiable conformal loop antenna for intramuscular implantable myoeletric sensors"GCCT conf. on 2015.

[10] C.A. Balanis "antenna theory analysis and Design" *fourth edi. John Wiley & Sons* 2016.

[11] Sajith k and Gandhimohan and T.Shanmuganantham "A novel SRR loaded CPW-fed antenna for implantable ISM band applications" *IEEE Conf. on Indian ant. Week2017.*

[12] Deepanshu kaushal ,Sajith k ,T.Shanmuganantham "dual band characteristics in a micro-strip rectangular patch antenna using Novel Slot" *IEEE Int. Conf. on (ICICICT),*July 2017.

BIOGRAPHY

Sajith.k, received the B.Tech degree from in College of Engineering Thalassery, kerala in 2011, and M.Tech degree in Pondicherry university in 2013, where he is currently pursuing the Ph.D degree in electronics and communication engineering. During his research carrier, he developed many wearable antennas for health monitoring applications and also he received best paper award in IEEE-ICRAET conf. in India. Email- sajithrajan999@gmail.com

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(**Received Gold Medal**) in the field of Antennas from NIT (National Institute of Technology), Tiruchirappalli in 2010 under the guidance of Prof.S.Raghavan, Senior Professor, Dept. of ECE, NIT, Tiruchirappalli. He has 21 years of teaching experience in various reputed Engineering Colleges and currently he is working as Asst. Prof. in the Dept. of Electronics Engg, School of Engg & Technology, Pondicherry Central University, Pondicherry. His research interest includes Antennas, Microwave/Millimetre-Wave Engineering and MEMS/NEMS. He has published 375 research papers in various National and International level Journals and Conference proceedings. He received many Best Paper awards. Five Ph.D. students awarded under his guidance. He has completed two sponsored projects worth of Rs.57 lakhs. He is potential reviewer for IEEE Trans. on Antennas and Propagation, MTT, PIER Journals, John Wiley, Elsevier, Taylor and Francis and many IEEE Conferences. He has been elected as Fellow in Antenna Test and Measurement Society (ATMS) by ISRO Scientists and a senior member in IEEE, a Life Member in ISSS, IETE, IE (India), CSI (India), Society of ISTE, EMC, ILA, OSI and ISI. He is serving as office bearer for IEEE Circuits and Systems Society (India Chapter) and also he is Member of Board of Studies in Pondicherry University, University of Madras, and Annamalai University. His biography was included in 'Marquis who is who in the world' USA in 2010.

