International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-4, November 2019

Microstrip Spork Patch Antenna for Integration Into Wearable Textile Substrates for ISM Band Applications

V.Ramkumar, S.Mahaboob Basha, A.Iyswariya, K.Jeevitha, V.Praveen Kumar

Abstract: A Wearable textile antenna is meant to be a part of clothing used for communication purposes like tracking, navigation, mobile computing and public safety's .The invention of wearable textile antenna exhibited the need for wireless communication tools into garments. A Spork shaped patch textile antenna is designed and simulated for the operation at Industrial, Scientific and Medical (ISM) band applications. The textile patch antenna is simulated using Computer Simulation technique software (CST), the textile material and patch provides the antenna to work in the frequency range of 2.4-5.8 GHz.These bands include designated frequency band of wireless standards IEEE 802.11 and IEEE 802.11b, Bluetooth, The designed antenna exhibits good radiation pattern, return loss, and gain for ISM band.

Keywords : Textile substrate, return loss, gain, Directivity ,ISM Band.

I. INTRODUCTION

Textiles present a good platform for developing smart textile systems combining electronics and antennas. Since textile antenna has good flexibility and conformable to the wear in daily life. A communication system based on Smart textile antennas can be fully integrated into different clothing. For example, a type of application for wearable antenna systems which includes monitoring the activity and life signs to protect and rescue workers active in their field with the electronics being integrated into protective textile antenna

Setting up the off-body wireless communication link between the wearer and the closest base station.Wearable intelligent smart textile system is an innovative fast growing field in application oriented field. Enhancement in communication and electronic technology has enabled the development of compact, flexible and intelligent smart antenna devices which can be located on the human body or implanted inside [2][6].

Manuscript published on November 30, 2019.
* Correspondence Author
Mr.V.Ramkumar*, Assistant Professor ,R.M.K.Engineering College,Chennai,TamilNadu,India,
Mr.S.Mahaboob Basha, Assistant Professor ,R.M.K.Engineering College,Chennai,TamilNadu,India,
Mrs,A.Iyswariya, Assistant Professor ,R.M.K.Engineering College,Chennai,TamilNadu,India,
Mrs.K.Jeevitha, Assistant Professor ,R.M.K.Engineering College,Chennai,TamilNadu,India,
Mr.V.Praveen Kumar, Senior Engineer, Nagman Instrumentation and Electronics Pvt.Ltd, Chennai, TamilNadu, India.

Wearable smart textile antennas are categorized as hard dielectric substrate antenna with low profile and small area flexible antenna with substrate of felt or different textile antenna.[1]These textile-based devices have demonstrated good electrical performance and mechanical flexibility. However, most of the reported electronic textiles so far are thin metallic wires, metallic tapes into clothes or sputtered nanoparticles [5]. In this paper the textile material used is jean with a dielectric constant of 1.6 and tangent loss of 0.0019 which provides the antenna to work in the frequency of 2.46 GHz with a return loss of -19.62 dB

II. DESIGN CONFIGURATION OF WEARABLE TEXTILE ANTENNA

For designing a patch smart textile antenna, a suitable selection of conducting material and non-conducting textile material is needed to be selected. In conducting materials copper is choosed and applied for both patch and the ground plane while the non-conducting jean textile is applied for the antenna substrate, for antenna substrate jean is chosen because of its good thickness and less permittivity of 1.6 which has good properties of textile antenna design. The 50 Ω micro strip feed-line is excited with a SMA connecter. Different substrates having different dielectric constants affect the antenna performance in various ways .Here, Fleece Fabric εr = 2.22 with a tangent loss of 0.0015, Cotton εr = 1.54 with a tangent loss of 0.058 ,and Jean εr = 1.6 with a tangent loss of 0.0019 are used as antenna substrates .Selection of material for designing the antenna is unique in this paper. Figure 1 shows the combined results of patch textile antenna designed using CST softwareAs shown in the figure.1 the compact size and simple shape of smart textile antenna reduces the difficulty of fabricating and it is easy to wear on outer most surface of human body.

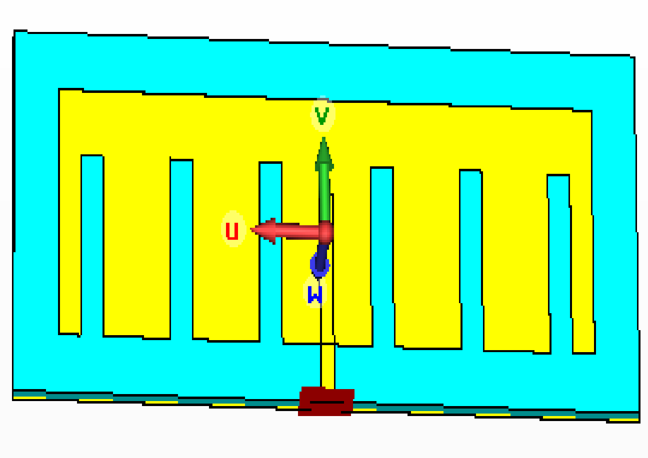

Fig 1: Combined View of spork shape textile antenna

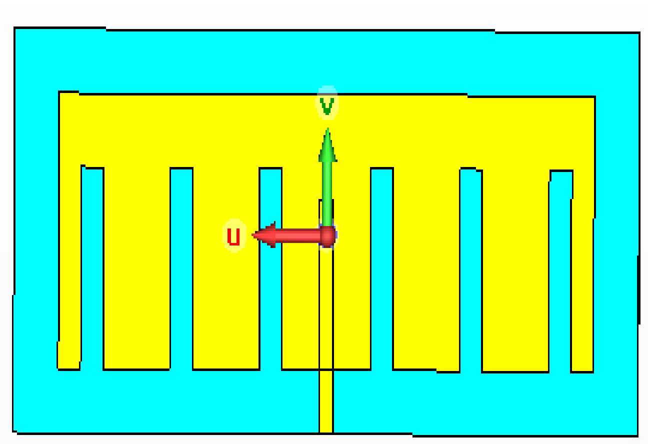

Fig 2 : Front view of spork shape textile antenna

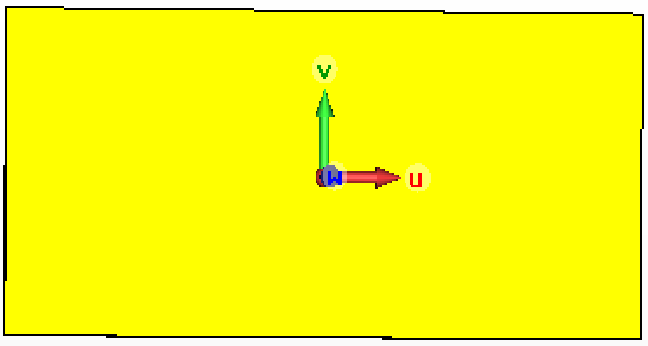

Fig 3 : Back View (G.P) of spork shape textile antenna

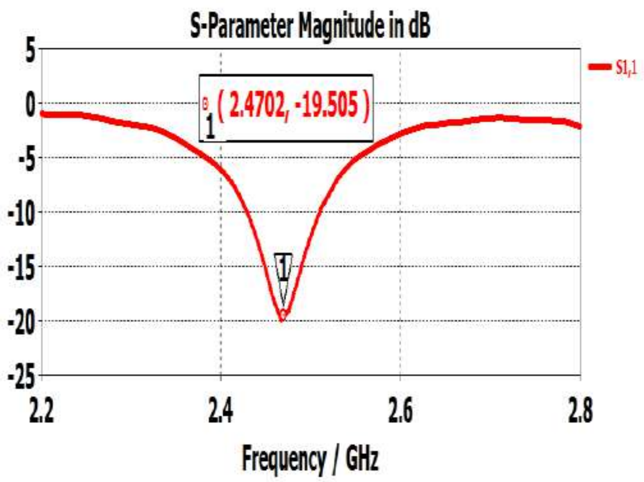

Fig 4: Return loss of spork shape textile antenna

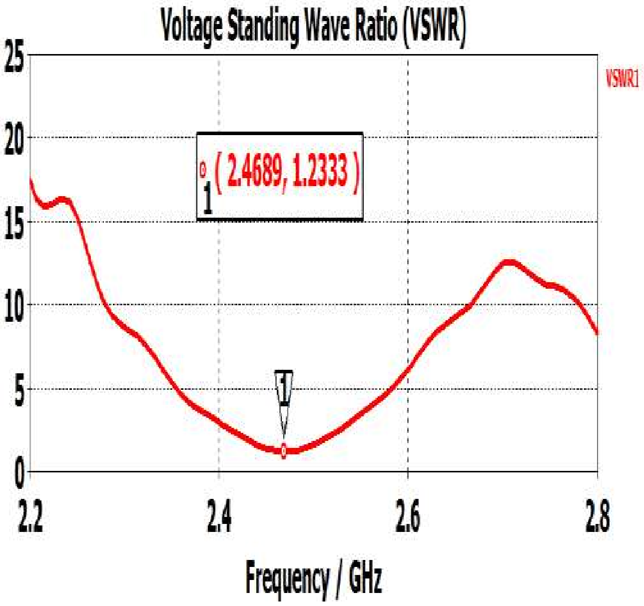

Fig 5 : VSWR of spork shape textile antenna

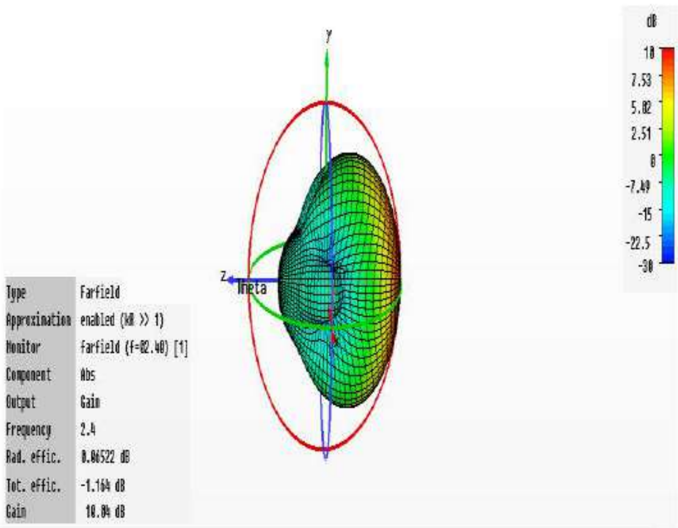

Fig 6: 3D View of Gain at frequency 2.4 GHz.

III. SIMULATION RESULTS

The dielectric material is chosen for designing the substrate is Jeans which have a dielectric constant of 1.6 and height of dielectric substrate (h) is 3 mm.The antennas is fedded by a 50Ω microstrip line impedance matching and simulated using CST software. From figure 4 it shows that the spork shape patch textile antenna works in the frequency of 2.47 GHz with a return loss of -19.50 dB, and figure 5 shows the voltage standing wave ratio of textile antenna with a value of 1.233.

Retrieval Number: D8795118419/2019©BEIESP
DOI:10.35940/ijrte.D8795.118419
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

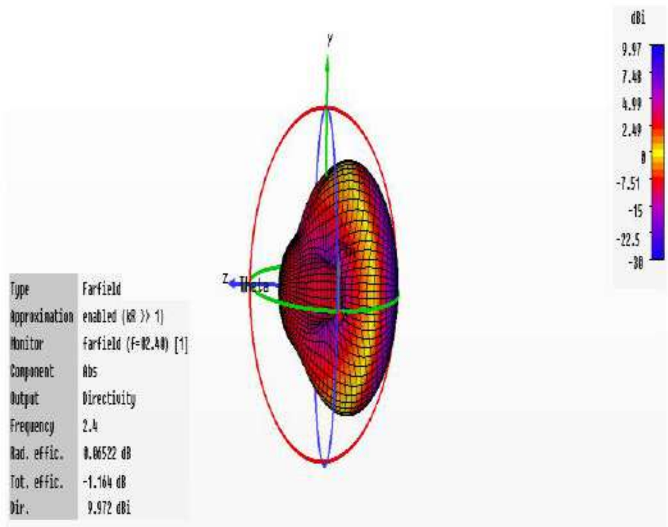

Fig 7: 3D View of Directivity at frequency 2.4 GHz.

Figure 6 and 7 shows the 3- Dimensional View of Gain and directivity of spork shape patch textile antenna which achieves a gain of 10 dB and directivity of 9.972 dBi.figure 8 and 9 shows the cartesian plot of gain and directivity of textile antenna.

Table 1 : Dielectric constants and tangent loss of textile substrates.

S:NO	MATERIAL	DIELECTRIC CONSTANT	TANGENT LOSS
1	Jean	1.6	0.0019
2	Cotton	1.54	0.058
3	Fleece fabric	2.22	0.0015

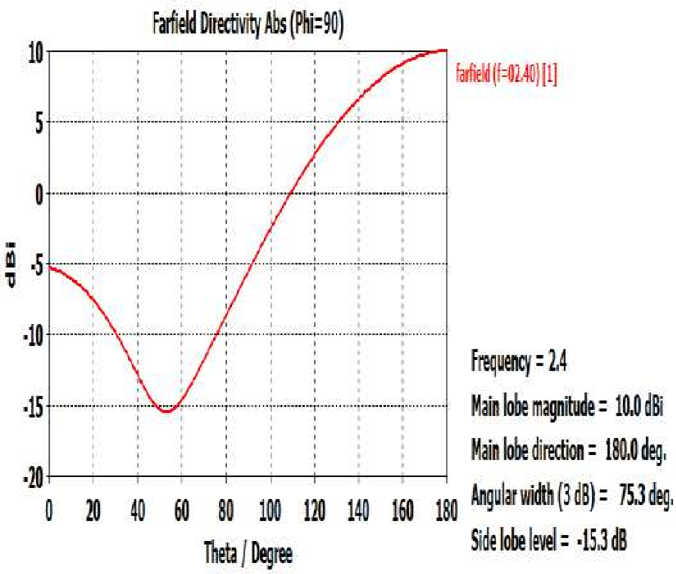

Fig 8 :Cartesian plot of Directivity at frequency 2.4 GHz.

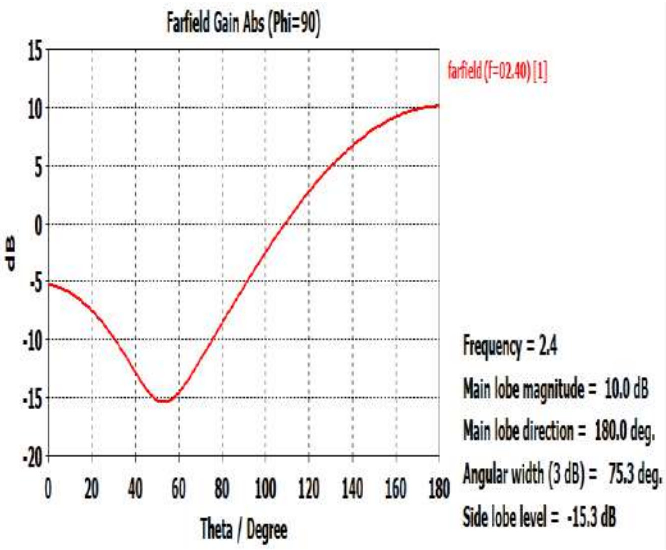

Fig 9: Cartesian plot of Gain at frequency 2.4 GHz.

Figure 10 shows the radiated power of spork shape patch textile antenna which shows the maxmium power is radiated at frequency of 2.47 GHz and helps to improves the effiency of textile antenna. The corresponding figures 11 and 12 shows the polar plot of gain and directivity at frequency of 2.4 GHz. The microstrip feed planar spork shape smart textile antenna works for a short range wireless communications and ISM band.Different wearable textile antennas with their dielectric constant and its tangent loss are listed in table 1.Among the different textile material Jean terxtile provides good efficiency, gain ,directivity,radiation pattern which operates at a frequency of Industrial,Scientific and Medical applications(2.4-5.8 GHz).

Fig 10: Radiated power of spork shape patch textile antenna.

Retrieval Number: D8795118419/2019©BEIESP
DOI:10.35940/ijrte.D8795.118419
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

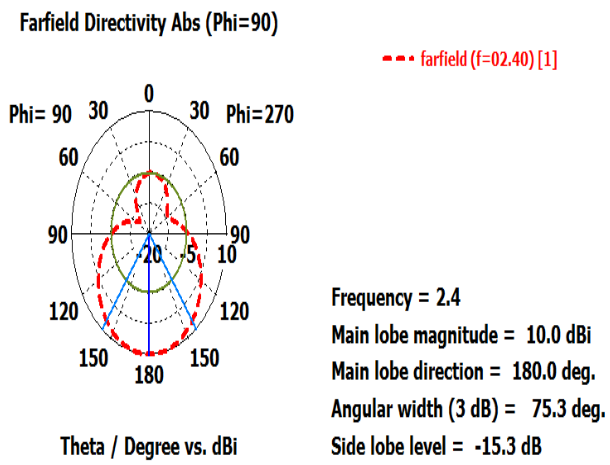

Fig 11: Polar plot of Directivity at frequency 2.4 GHz.

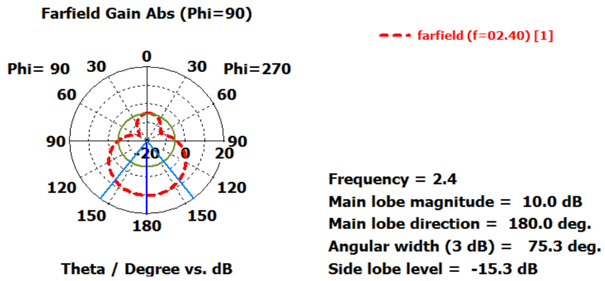

Fig 12: Polar plot of Gain at frequency 2.4 GHz

IV. CONCLUSION

The design of spork shape patch smart textile antenna is presented for ISM band applications and the antenna is designed and successfully simulated using CST software.The antenna has good properties and also easy to manufacture and reduces the overall fabrication cost.Furthermore, the smart textile antenna shows improved stability , gain and efficiency to be applied in a wireless communications.

REFERENCES

1. Sankaralingam, S. and B. Gupta, Development of textile antennas for body wearable applications and investigations on their performance under bent conditions," Progress In Electromagnetics Research B, Vol. 22, 53-71, 2010
2. I. Locher, M. Klemm, T. Kirstein, and G. Tröster, Design and characterization of purely textile patch antennas, IEEE Trans. Adv. Packaging, vol. 29, pp. 777-788, Nov. 2006.
3. Y. Ouyang, E. Karayianni, and W. Chappell, Effect of fabric patterns on electro textile patch antennas, in Proc. IEEE AP-S Int. Symp.,Washington DC, Jul. 2005, vol. 2B, pp. 246-249.
4. C.A. Balanis, Antenna Theory (Analysis and Design), 2nd edition. New York: John Wiley and Sons, Inc., 1997.
5. C. Hertleer, F. De Clercq, A. Tronquo, H. Rogier, and L. Van Langenhove,Design of textile antennas for smart clothing, in AUTEX 2006,Proc. CD-ROM, Raleigh, NC, Jun. 2006.
6. K. Chan, R. Cleveland, and D. Means, Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields in OET Bulletin 65, 9701 ed. , 1997, vol. Supplement C.
7. Pitra, K. and Z. Raida, Miniaturized antenna for body centric communication," 2013 7th European Conference on Antennas and Propagation (EuCAP), 3219-3222, 2013.
8. R. Garg, P. Bhartia, I. Bahl, and A. Ittipiboon, Microstrip Antenna DesignHandbook. Reading, MA: Artech House, 2001
9. Kaivanto, E. K., M. Berg, E. Salonen, and P. de Maagt, Wearable circularly polarized antenna for personal satellite communication and navigation," IEEE Transactions on Antennas and Propagation, Vol. 59, No. 12, 4490-4496, 2013.
10. Zhu, S. Z. & Langley, R. (2009). Dual-band wearable textile antenna on an EBG substrate.

AUTHORS PROFILE

Mr.V.Ramkumar, is currently working as an Assistant professor in the department of Electronics and Communication Engineering at R.M.K.Engineering College He received his Bachelor degree in Electronics and Communication Engineering and post graduate degree in Communication Systems from Anna University, Chennai. His research interest is in RF and Microwave Engineering and Embedded System. He is a life member of the Indian society of technical education and also member of International Association of Engineers.

Dr. S. Mahaboob Basha is currently working as Assistant professor in department of ECE, R.M.K. Engineering College. He received his B.E in ECE from Anjuman Engineering College, Karnataka University, India in 1998 and M.E, Applied Electronics in GCT, Coimbatore in 2003. He has completed Ph.D. in Anna University in the area of VLSI Design in August 2019.His area of interest is in the field of VLSI and Signal processing. He is a life member of the Indian society of technical education. He has published 9 papers in International Journals and 10 papers in Conferences.

Ms.K.Jeevitha, was received the B.E. degree in Electronics and Communication Engineering from the Anna University, India, in 2005 and M.E. degree in Applied Electronics from Anna University, Chennai ,India in 2010. She is Currently working as Assistant Professor at R.M.K. Engineering College, Tamilnadu, India and her research interest is in VLSI design and Embedded System. She is a life member of the Indian society of technical education and also member of IACSI

Ms.A. Iyswariya, received her B.E degree in Electronics and Communication Engineering and M.E. in Applied Electronics from M.N.M. Jain Engineering College ,affiliated to Anna University , Chennai. She is currently working as Assistant Professor in R.M.K. Engineering College, Chennai, Tamil Nadu , India. Her research interests are Image Processing and VLSI design. She is a life member of the Indian society of technical education.

Mr.V.Praveen Kumar, was received his B.E. degree in Electronics and Instrumentation Engineering from the Anna University, India, in 2010 and He is Currently working as a Senior Engineer at Nagman Instruments and Electronics Pvt Ltd, Tamilnadu, India and his research interest is in Instrumentation sectors and PCB Design.