International Journal of Innovation Sciences and Research
Vol.4, No, 4, pp. 163-165, April- 2015

Available online at
http://www.ijisr.com

RESEARCH ARTICLE

DUAL BAND SQUARE SHAPED SLOTTED PATCH ANTENNA FOR WEARABLE APPLICATIONS

***Muthu Krishnan, R. and Dr. Tamil Selvi, S.**

Department of ECE, National Engineering College, Kovilpatti, Tamil Nadu, India

Accepted 13th March, 2015; Published Online 30th April, 2015

ABSTRACT

Design of square patch antenna for wearable applications operating in GPS (1575 MHZ) and 3G (2100 MHZ) bands is presented .The proposed square patch antenna have circular ring slot in center of patch and two horizontal slits in the edge of patch antenna. The slot radius and slits length is varied and their effect on performance of the antenna is studied.

Key Words: Wearable Antenna, Square patch antenna, Dual band.

INTRODUCTION

Advances in wearable communication leads to extensive growth in wearable antenna. Wearable antenna is antenna that uses textile material as dielectric substrate. By implementing operating bands of GPS and 3G networks in wearable antenna make it suitable for integrated into perfect rescue devices. In wearable advances, by integrating antenna into clothing it needs to satisfy flexibility, crumpling, and bending scenario. Wetness by the body of the human makes considerable performance degradation in the antenna performance. The challenge in the wearable antenna is proximity of human body which means the body converts Electric Fields into heat. Different fabric materials have been proposed to be used as patch material for wearable antenna (Tronquo *et al.,* 2006) which gives more flexibility suitable for embedded into clothing. Various textile polymers analysed to implement as dielectric substrate in wearable antenna (Sankaralingam and Gupta, 2010). In the proposed square patch antenna jeans fabric is used as dielectric substrate which contains low dielectric constant. In wearable antenna, Dual Band antenna is designed for 1G and 2G bands in (Esther Florence Sundarsingh, 2014). The use of textiles in wearable antennas requires the characterization of their dielectric constant parameters which analysed in (Rita Salvado *et al.,* 2014) and (Aris Tsolis *et al.,* 2014). Embroidery and related antenna fabrication techniques for wearable antennas is discussed in (Aris Tsolis *et al.,* 2014). The dielectric constant of various six textile material is determined using resonance method and suitable textile material for werable antenna is analyzed in (Sankaralingam and Gupta, 2010). Wearable antenna performance at crumpling conditions and bent conditions are tested and verified in (Sankaralingam and Gupta, 2010). In the proposed antenna due to low cost and easy to fabricate , copper sheet is chosen as ground plane and patch. The proposed wearable antenna can be integrated into device which is capable of finding location of the person using GPS and sent the location via 3G devices. The organization of the paper is as follows the antenna design parameters are explained in section II. The simulation results and discussions are presented in section III and the conclusion is given in section IV.

****Corresponding author: Muthu Krishnan, R.***
Department of ECE, National Engineering College, Kovilpatti, Tamil Nadu, India.

Antenna Design

The conventional patch antenna consists of dielectric substrate sandwiched between ground and patch material. The low cost copper plane sheets with thickness 0.1 mm used as a patch and ground plane of the proposed antenna. The jeans fabric with thickness 0.57 mm is selected as dielectric material. Its dielectric constant (ξ_r) is 1.6 and loss tangent value (δ) is 0.025 (Esther Florence Sundarsingh, 2014). The proposed square shaped patch antenna use patch length ($\lambda/2$) which is computed using standard antenna designing equation [9]. Length of the square patch is calculated using 3G band 2100 MHz and approximated as 60 mm. In this proposed antenna, higher frequency (f_2) is 2100 MHZ and lower frequency (f_1) is 1575 MHZ. To make the antenna resonate in dual band, antenna coaxial feed location is optimized to a value (17, 17) and 50Ω feed is given via SMA connector in this point.

Then the dual band is miniaturized to particular dual frequency by inserting circular ring slot and two horizontal slits. The circular ring slot consists of outer ring and inner ring with radius 15mm and radius 11 mm respectively. The slot width between the ring slots gives small impact in the antenna performance .Two horizontal slits introduced at the edge of the patch having length is 12.5 mm and width 2mm. The slits length responsible for miniaturization of fundamental resonating mode to 3G networks band 2100 MHZ. The dimensions of slot radius and slits length is adjusted using surface current distribution which is shown in Fig.1.2 The dense current distribution in the edges of the horizontal slits for 2100 MHZ is shown in Fig. 1.3 which proves that in proposed antenna slits are responsible for resonating in 2100 MHZ.

RESULTS AND DISCUSSION

The proposed square slotted patch antenna is designed using IE3D software. The simulated results for S_{11} plot is shown in figure. In simulation in IE3D, ground plane is taken as infinite ground plane and feeding coaxial cable are not considered in simulation.

The simulated patch structure using IE3D is shown in Fig.1.1.

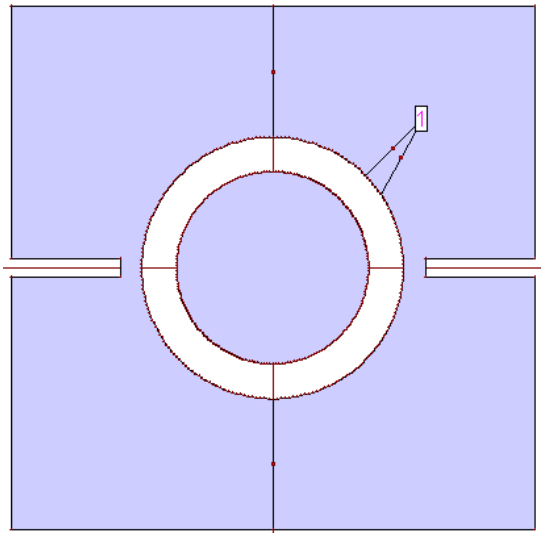

Fig. 1.1. Simulated Patch Structure using IE3D

The current distribution across the patch while proposed antenna resonating in 1575 MHZ using IE3D is shown in Fig. 1.2.

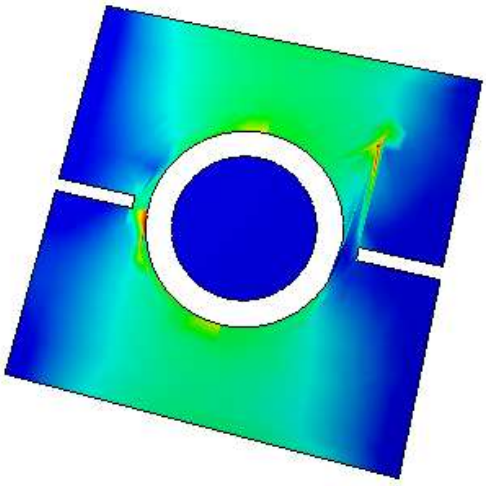

Fig. 1.2. Current Distribution at 1575 MHZ

The current distribution across the patch while proposed antenna at 2100 MHZ using IE3D is shown in Fig. 1.3.

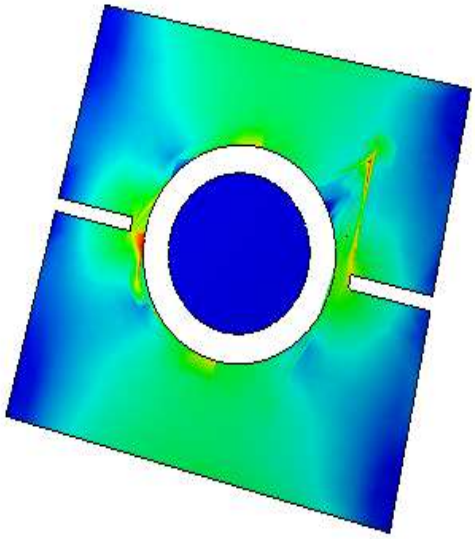

Fig. 1.3. Current Distribution at 2100 MHZ

The S_{11} Response of the proposed antenna using IE3D is shown in Fig.1.4.

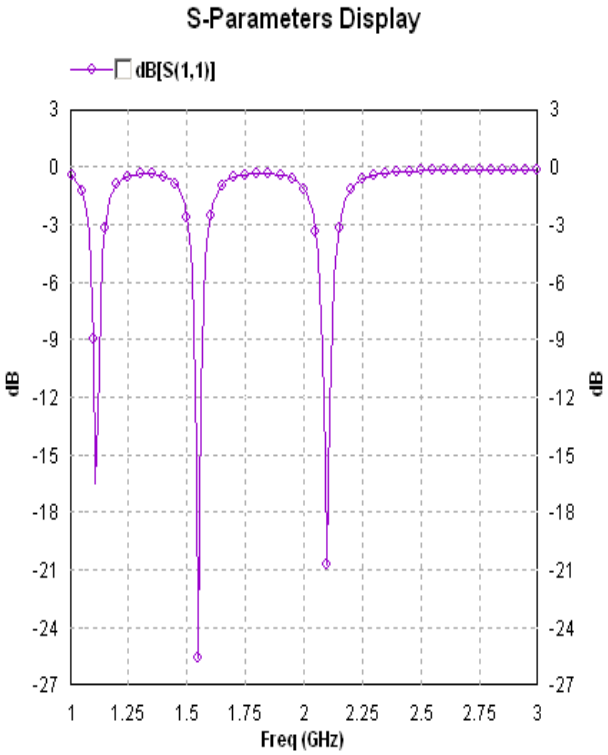

Fig. 1.4. S_{11} Response of the proposed antenna using IE3D

The 3D radiation pattern of the proposed antenna while resonating at 2100 MHZ using IE3D is shown in Fig.1.5.

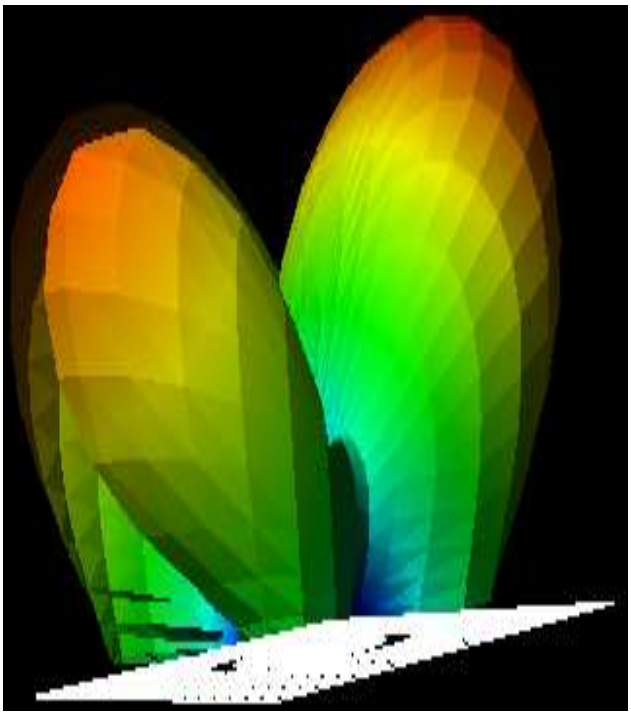

Fig. 1.5. 3D Radiation Pattern at 2100 MHZ using IE3D

The 3D radiation pattern of proposed antenna while resonating at 1575 MHZ using IE3D is shown in Fig.1.6.

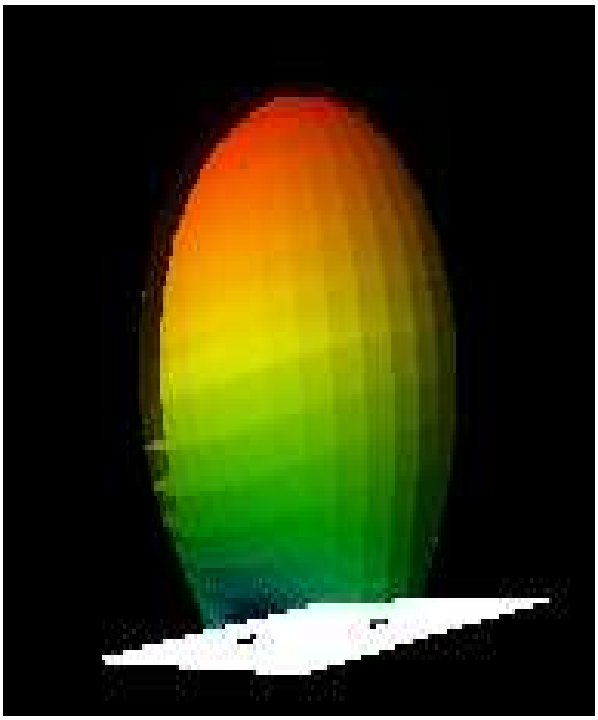

Fig. 1.6. 3D Radiation Pattern at 1575 MHZ using IE3D

Conclusion

The proposed square shaped slotted patch antenna resonates at 1575 MHZ and 2100 MHZ with S_{11} response 13.5 dB and 21 dB. The VSWR is 1.9 and 1.24 at 1575 MHZ and 2100 MHZ respectively. The performance of the proposed antenna is good at 2100 MHZ and acceptable at 1575 MHZ therefore performances at 1575 MHZ GPS Frequency need to be improved.

REFERENCES

Tess Acti, Alford Chauray, Shiyu Zhang, William G. Whittow, Rob Seager, J. (Yiannis) C. Vardaxoglou, and Tilak Dias. 2014. Embroidered Wire Dipole Antennas Using Novel Copper Yarns" IEEE Antennas and wireless propagation letters.

Lee, D. H., Lee, H. J., Lee, Y. W. and Shin, D. H. "Wireless broadband services and network management system in KT," *Int. J. Netw. Manage.,* Vol. 16, 429{442, 2006.

Jung, J., Lee, H. and Lim, Y. Modi ed helix chip antenna for Wi Bro and WLAN applications," Electronics Letters, Vol. 44, No. 11, May 22, 2008.

Tronquo, A., Rogier, H. Hertleer, C. and Van Langenhove, L. Robust planar textile antenna for wireless body LANs operating in 2.45 GHz ISM band," Electronics Letters, Vol. 42, No. 3, February 2, 2006.

Sankaralingam, S. and Gupta, B. \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.

Garg, R., Bhartia, P., Bahl, I. and Ittipiboon, A. Microstrip Antenna Design Handbook, Artech House, 2001.

IE3D Electromagnetic Simulator from Zeland Software Inc., USA, 2004, Release 10.12.

Esther Florence Sundarsingh and sangeetha velan. 2014. "Polygon –Shaped Slotted Dual-Band Antenna for Wearable Applications" IEEE Antennas and wireless propagation letters , Vol 13,2014.

Balanis, C. A. Antenna Theory : Analysis and Design , 3rd edition Hoboken, NJ, USA: Wiley 2012

Rita Salvado, Caroline Loss, Ricardo Gonçalves and Pedro Pinho. 2014. "Textile Materials for the Design of Wearable Antennas:ASurvey"www.mdpi.com/journal/sensors.

Aris Tsolis, William G. Whittow, Antonis A. Alexandridis and J. (Yiannis) C. Vardaxoglou. 2014. " Embroidery and Related Manufacturing Techniques for Wearable Antennas: Challenges and Opportunities"www.mdpi.com/journal/electronics.

Sankaralingam, S. and Gupta, B. 2010. "Determination of Dielectric Constant of Fabric Materials and Their Use as Substrates for Design and Development of Antennas for Wearable Applications" IEEE Transactions On Instrumentation And Measurement, Vol. 59, No. 12.

Sankaralingam, S. and Gupta, B. "Development Of Textile Antennas For Body Wearable Applications And Investigations On Their Performance Under Bent Conditions" Progress In Electromagnetics Research, B, Vol. 22, 2010.

Timothy, F. Kennedy, Patrick, W. Fink, Andrew, W. Chu, Nathan, J. Champagne, II, Gregory Y. Lin, and Michael A. Khayat," Body-Worn E-Textile Antennas: The Good, the Low-Mass, and the Conformal " IEEE Transactions On Antennas And Propagation, Vol. 57, No. 4, April 2009 .

****