A Review of Wearable Spiral Antenna

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Abstract
Use of wearable fabric materials as antenna substrate has been rapid because of the ongoing scaling down of remote devices. A wearable antenna is to be a piece of the attire used for wireless communication purposes, which include public safety, mobile and wearable computing, tracking and positioning of essential goods/products; providing remote medical patient monitoring; enabling for sports training and entertainment purposes. For user accommodation there is an expanding requirement for incorporating antenna on or in the cloth. The conventional antennas are not adaptable and troublesome for user to movements. There is a need of antennas made of wearable fabric materials that can be a piece of user clothing are characterized as wearable antennas. Specifically the micro strip patch antennas are recommended for body-worn applications, as they primarily transmit oppositely to the planar structure and furthermore their ground plane effectively shields the body tissues. This paper indicates investigate on wearable patch antennas outlined and developed for various applications.

Keywords: *Spiral Patch Antenna, Substrate Fabrics, Body-worn applications*

INTRODUCTION

Antenna is the most vital component in wireless communication system design. The rapid development in mobile communication systems particularly Body Area Networks (BANs) and Personal Area Networks (PANs) demands for efficient antenna design. Wearable electronic devices are becoming very popular in personal communications, computer systems and wireless monitoring of vital functions. Similarly, police and military operations (e.g., surveillance and reconnaissance) can also benefit from wearable units. Communication systems designed in support of these operations use designated frequency bands, which have been carefully chosen to make the functional requirements compatible with radio wave propagation characteristics in urban areas. Wearable technology is an electronic and PC technologies that are joined into garments or gadgets that can be worn on daily routine. The wearable gadgets can be glasses, watches, hoops and fabrics. These gadgets are not just proficient to perform undertakings like cell phone and PCs yet likewise can give tactile, following and filtering highlights. Despite the fact that wearable devices are intended for devices that can be put on and taken off easily, there are sorts of devices that are embedded to human body. It implies that the antenna is installed inside the human body.

The main challenge is on power proficiency. The activity of wearable gadget is completely relying upon battery power. The primary vitality utilization is from transmitting parcel information. Along these lines, it is critical to have a plan with ideal vitality utilization to guarantee the information can be transmitted for longer period. Another challenge is radiation degradation because of human body tissues and human motion. Human bodies are not the same as to each other. It is critical to distinguish the part in the tissues that should be considered for antenna structure. The movement of body parts additionally will diminish antenna performance. We can't limit the movement, in this manner we have to recognize which body part that is less affected by movement.

Remote correspondence is effectively affected by ecological factors, for example, transient physical obstacles. Signals can be corrupted because of impedance from different remote devices. This can keep the information to be proficiently transmitted and diminish the execution of the gadget regarding reliability and energy efficiency. It is turned out to be all the more difficult when the signal can be distorted by human body. These factors should be routed to guarantee the antenna bandwidth and throughput can be ideally designed.

RELATED RESEARCH

M. I. Ahmed [1], proposed multiband wearable fractal antenna might be joined to life coat to help for finding the human body if a mishap occurred thus, the explicit ingestion proportion (SAR) must be determined. Another intended to diminish the SAR esteem with a spiral Meta material wandered in the ground plane is presented. It is designed by CST simulator 2014 and it is fabricated on FR4 substrate by photolithography procedure. The permittivity of the substrate is 4.4, the substrate thickness is 1.6 mm, and tan δ = 0.02. The estimating results were gotten utilizing Agilent 8719ES VNA. The antenna is appropriate for GPS, WiMax and Wi-Fi (Bluetooth) applications in a similar time. Also, it is intended to work at four resonant frequencies are 1.57, 2.7, 3.4 and 5.3 GHz. In this way the most extreme SAR esteem is 0.925 W/Kg. At long last, the designed antenna is worked appropriately in the region of the human body.

Sweety Purohit [2], investigated on wearable patch antennas designed and simulated for different applications at 2.45 GHz recurrence. Material utilized here is jeans; its dielectric consistent is 1.6. The height of substrate is 3.5mm in light of the fact that less than 3.5mm it not gives return loss at want level. Here the antenna is planned and simulated using HFSS. The SMA connector is soldered by general technique. The antenna displayed return adaptable, and it is anything but difficult to manufacture. As indicated by simulated results return loss is - 32.57 dB at 2.45 GHz and gain is 7.2. Fabricated return loss is -30dB at 2.4945GHz. This antenna can be flawlessly incorporated into apparel which is an ideal component for hands free applications and military applications requiring low visibility.

Shuvashis Dey [3], in this paper the plan of wearable antenna for materials with three distinctive substrate permittivity εr =3, 2.2, 1.25 are figured it out. Distinctive substrates having diverse permittivity influence the antenna performance in different ways. Here, Microstrip Patch Antenna is intended for narrow band WBAN (Wearable Body Area Network) at the frequency of 2.45GHz. For this situation, Dacron material, woven fiberglass fabric and Fleece fabric are utilized as antenna substrates and woven copper threads are utilized as the conductive piece of patch antenna. This paper shows the impacts of antenna bowing at five unique points. Here, resonant frequency fluctuation because of impedance matching and additionally impacts of radiation pattern deforming because of bending at various edges are engaged. It has been seen that for substrate permittivity εr =2.2 impedance matching is superior to others with return loss of -

34.44db and resonance frequency of 2.4604 GHz.

Jingni Zhong [4], designed a novel load-bearing spiral antenna on conductive material threads (E-thread) for conformal applications. The proposed antenna is a 160mm-distance across Archimedean spiral with the ground plane set 25mm beneath the antenna aperture. This spiral has 3.5 turns and a slot width of 2mm. It was intended to work from 0.3 GHz to 3 GHz. Urethane froth was utilized to fill the reflecting cavity for stability. The key highlights of the proposed antenna are: i) flexibility and conformality, ii) mechanical performance, iii) about 10:1 VSWR bandwidth from 0.3 to 3 GHz, and iv) close steady circularly captivated gain of 6.5 dBi over the 1 to 3 GHz band. The antenna and its ground plane were weaved utilizing another class of Elektrisola E-thread that can accomplish geometrical accuracy as high as 0.1mm. Such execution has at no other time been accomplished on materials and adaptable surfaces. Essentially, the spiral indicated non-apparent changes in execution, even after 300 flexing cycles. Repeatability of this textile fabrication technology was additionally affirmed out of the blue.

Pranita Manish Potey [5], In this paper, rectangular microstrip antenna with four distinctive materials cotton, polyesters, Lycra and cordura with various estimations of dielectric constant at same frequency that is 2.45GHz is chosen. Relative permittivity of textile materials cotton, polyester, lycra, Cordura are 1.60, 1.90, 1.90, 1.50 separately. Further figuring of length width and feed point are finished utilizing the technique notice in Balanis book. Zeland Inc's IE3D programming is utilized to reenact the proposed wearable material fix. Relative measurement and performance characteristics of every one of the four antennas are analyzed. From relative investigation of result it is inferred that, the general execution of antenna utilizing polyester fabric is better as contrast with other three. This is because of low value of loss tangent that is 0.0045 as for other material. In some explicit use of remote body zone arrange, antenna with high directivity is required, antenna with lycra and cordura material are great possibility for it. Here directivity of cordura is similar to lycra in this manner the two antennas can be utilized. From above investigation it is finished up, lesser estimations of substrate dielectric constant are valuable as it limits surface wave losses and it is likewise useful to direct propagation of wave inside the substrate. Additionally, low loss substrate material determination is essential prerequisite to increase efficiency.

Vijayalakshmi [6], presented a paper on the spiral formed monopole wearable antenna working at 403 MHz for remote body observing application with measurement of 35 x 25 x 1.6mm^3. The proposed antenna has spiral geometry patch with microstrip line feed on FR4 substrate material of relative permittivity of 4.4 and thickness of 1.6mm with fractional filled ground plane. The length and width of spiral arm is balanced so as to get wanted full recurrence. It has been investigated and the simulated using HFSS software for 403MHz with reliable radiation example and uniform gain. It is planned on FR4 substrate with lessened size, when contrasted with inverted F antenna arrangement with a square spiral segment and rectangular patch element. The deliberate outcomes demonstrate a - 11 dB return loss bandwidth of 4.5 MHz, and a realized gain of −20dBi with omnidirectional radiation characteristics.

Haider K. Raad [7], is designed a antenna to give Wireless Local Area Network (WLAN) and Long Term Evolution (LTE) connectivity. The design shows a generally wide bandwidth (1600-3500 MHz underneath - 6 dB impedance bandwidth limit). The antenna is situated on a 33 mm x 30 mm adaptable substrate with a thickness of 50 μm. Kapton Polyimide film was chosen because of its alluring physical and synthetic characteristics and electromagnetic properties with a low loss tangent over a wide frequency range (tan δ =0.002). In addition, they are accessible at low thicknesses and offer a rigidity of 165 MPa at 73 °F. It additionally shows a dielectric resistance of 3500-7000 volts/mil. Design and simulation of the exhibited wearable slot antenna have been completed utilizing the 3D full wave electromagnetic simulation bundle CST Microwave Studio which depends on the Finite Integration Technique (FIT). Return loss for antenna is around 16.8 dB at 2.05 GHz, with a - 10 dB bandwidth of 900 MHz extending from 1600 to 3500 MHz and increases of 3.28 dBi at 2.45 GHz.

M. Annakamatchi [8], proposed a wearable antenna for ISM band with the component of 36mmX28mm rectangular formed fleece substrate material. The substrate material having the permittivity of 1.3, dielectric consistent of 3.2, tangent loss of 0.025mm and thickness of 3mm. The spiral antenna has been designed using CST Microwave Studio (CST-MWS) to work at the frequency of ISM band. The antenna resonates at the frequency of 2.6GHz with low return loss which is evaluated - 38 dB. The gain acquired by the proposed antenna is 3.65 dB This paper involves the plan of spiral antenna with fleece substrate coordinated into garments for biomedical applications. As the structured antenna is basic, savvy and little in size, it encourages joining into fabric for different applications.

CONCLUSION

From the review, it is concluded that there are a few extra viewpoints to be considered when designing a wearable antenna, in contrast with a traditional antenna. It demonstrated that there exists a range of potential materials that could be utilized in planning wearable antenna. Here there is an issue with designing a size of antenna. So it very well may be plan with reduced size with safe wearable material. Wearable antenna is promising, and brags an incredible future close by the advancement of the quickly developing remote devices.

REFERENCE

1. Ahmed M. I and M. F. Ahmed (2016), 'A Novel Wearable Meta material Fractal Antenna for Wireless Applications,' IEEE Transactions on Antennas and Propagation.
2. Sweety Purohit and Falguni Raval (2014), 'Wearable -Textile Patch Antenna Using Jeans as Substrate At 2.45 GHz,' International Journal of Engineering Research & Technology (IJERT), Volume. 3 Issue 5.
3. Shuvashis Dey et al (2011), 'Design and Performance Analysis of Narrow Band Textile Antenna for Three Different Substrate Permittivity Materials and Bending Consequence,' Loughborough Antennas & Propagation Conference IEEE, Volume: 08, 2011.
4. Jingni Zhong et al (2016), 'Conformal Load-Bearing Spiral Antenna on Conductive Textile Threads,' IEEE Antennas and Wireless Propagation Letters, Volume: 71.
5. Pranita Manish Potey and Kushal Tuckley (2018), 'Design of Wearable Textile Antenna with Various Substrate and Investigation on Fabric Selection,' 3rd International Conference on Microwave and Photonics (ICMAP 2018), IEEE, and Volume: 18.
6. V. Vijayalakshmi and T. Shanmuganantham (2017), 'Design of Microstrip Fed Spiral Shaped Antenna for Wearable Systems,' International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), IEEE, Volume: 17.

7. Haider K. Raad (2017), ‘A Compact Wearable Slot Antenna for LTE and WLAN Applications,’ World Academy of Science, Engineering and Technology International Journal of Electrical and Computer Engineering, Volume: 11, No:2.
8. M. Annakamatchi and V. Keralshalini (2018), ‘Design of Spiral Shaped Patch Antenna For Bio-Medical Applications,’ International Journal of Pure and Applied Mathematics, Volume 118, page no: 131-135.
9. Constantine A. Balanis (2016), ‘Antenna Theory Analysis and Design, Fourth Edition,’ John Wiley and Sons.

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