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ULTRA WIDE BAND ANTENNA USING FR4 SUBSTRATE FOR WBAN APPLICATIONS

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ABSTRACT

This seminar introduces a small-sized, low-profile, planar and flexible ultra-wide band (UWB) antenna using natural rubber as the substrate. It is the primary approach in using natural rubber as the substrate for UWB antenna. The UWB antenna is designed for applications in WBAN, which is the current revolution in wireless sensor networks. The antenna operates from 3.1-10.6 GHz, which is a candidate for WBAN operation. The flexible nature of the antenna makes it convenient for the use as a body worn antenna for WBAN. This paper is a case study of whether rubber can be used as a substrate for UWB antenna and compares the performance using FR4 substrate. A UWB (ultra wideband) antenna are gaining prominence and becoming very attractive in communication system. A compact triple multi- band slotted bow tie patch antenna is design to meet requirement of the multiple operating frequency. This antenna has simple structure generated by etching slots of different lengths in a bow type patch. The length of each bent monopole is determined under the quarter wavelength resonance condition. The bow type patch treated as a broad band impedance matching structure. A triple band bow-tie monopole antenna for WLAN/WiMAX/LTE application with the bands of 3.1-10.6 GHz .The antenna is fabricated on a 0.8 mm-thick FR4 substrate.

Keyword: Ultra-wide band (UWB) antenna, FR4 substrate.

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I. INTRODUCTION

Wireless devices and systems created on Ultra Wide Band radio technology, with the frequency distribution of 3.1–10.6 GHz, which support low output power and the higher data rate (110–200 Mb/s) applications over short ranges of (4–10 m).UWB antennas must be electrically minor and low-cost without negotiating on performance. UWB can be efficiently used for Wireless Body Area Network due to its ultra-low power consumption, and large bandwidth of availability. This project presents a small-sized, low-profile, planar and flexible ultra-wide band antenna using FR4 as a substrate. This is primary method by using natural rubber as a substrate for UWB antenna.

This antenna is proposed for use in Wireless Body Area Network, which is the current revolt in wireless sensor network area. The antenna works from the range of 3.1 to 10.6 GHz, which is a candidate for WBAN applications .This antenna is flexible in nature that's why it easy to use for the body worm antenna for Wireless Body Area Network in the on-body as well as off-body communications, IEEE802.15.6 specifies both the narrowband as well as wideband frequency areas, such as Industrial, Science and Medical at 868 MHz , 915 MHz , 2.4 GHz or Ultra Wide Band at 3.1-10.6 GHz.

II. LITERATURE SURVEY

[1].Chih-Peng Lin, Chieh-Hsiang Chang, Y. T. Cheng, "Development of a Flexible SU 8/PDMS-Based Antenna" IEEE antennas and wireless propagation letters, vol. 10, 2011

Proposed Method: A stretchy SU-8/PDMS-based antennas were demonstrated, not only for directing the wearable calculating, but too fitting of well in the RF system-on-package applications.The features of the suggested antenna fabricated on a flexible polymer substrate (SU-8/PDMS) with different twisting angles have been effectively measured and categorized for the first time.

Remark: Fabrication Process able to integrate itself with CMOS chips for flexible RFIC's application .The bandwidth and maximum gain are 3% from 6.2 to 6.4 GHz and 2.17 dB .Radiation pattern in -plane owing to the reduction of capacitance

[2] J. C. G. Matthews, G.Pettitt" Development of Flexible, Wearable Antennas"2012

Proposed Method: This paper presents the development of wearable antennas which are integrated into clothing. This work considers antennas operating from the 100MHz to 1GHz.Advantages as well as the disadvantages of several construction methods and materials are discussed in this paper. It measures the radiation patterns and the input impedances which are presented for integrated antenna of the body.

Remark: It proposed new manufacturing techniques and methods to certain methods to integrated antennas in the cloths. The Phosphor Bronze mesh, LCP and Copper coated fabric having the advantage that the antennas are directly to be soldered as mentioned in the paper.. The Nylon, painted and screen printed antennas used conducting Epoxy. In the case of RF performance, the conducting thread spiral performed very worst than any other antenna and it was completely lossy. The Bowtie antenna having advantage that the feed cable can perpendicularly far from the antenna axis so does not affect the radiation patterns. The spiral antenna requires the feed cable is brought across the antenna which causes some small asymmetries pattern.

[3]Riaz Ahmed Liyakath, ArashTakshi, and GokhanMumcu, " Multilayer Stretchable Conductors on Polymer Substrates for Conformal and Reconfigurable Antennas" IEEE antenna and wireless propogation letters , vol. 12, 2013

Proposed Method: The Aperture-coupled patch antenna is designed, fabricated, and tested .Additionally, a patch antenna can be fabricates by using the multilayer SC to exhibits 6.18 dB recognized gain. This gain is 3.71 dB better than the patch antenna implemented from a separate conductive Rubber layer, and only 0.4 dB lower than that of a straight patch.

Remark: For implementing reconfigurable antennas ended flexible substrates the multilayer stretchable conductors are as an another cost effective method .The patch antenna applied by using a standalone conductive rubber layer having the better gain i. E. 3.71 dB

[4]Riccardo Cavallari, FlaviaMartelli, Ramona Rosini. " A Survey on Wireless Body Area Networks Technologies and Design Challenges".

Proposed Method: Presents an summary of WBAN main applications, skills and standards, issues in WBANs design, and developments**.** Also presents case studies built on both real implementation and experimentation on the field.

Remark: It defines the main standards which can be used as a reference in a RF-based WBAN design paying more attention to the IEEE 802.15.6. It introduced the main issues in a WBAN design, namely the peculiarities of the radio channel, the power consumption and the coexistence with other RF based systems.

[5]Bahadir S. Yildirim,Bedri A.Cetiner, " Integrated Bluetooth and UWB Antenna" Gemma Roqueta,Student Member,IEEE,and LuiesJofre,Member,IEEE 2009.

Proposed Method: This work described the main small size, low , then planar integrated Bluetooth and UWB antenna that satisfies requirements of performance of both the technologies. The trade off of integrating UWB and Bluetooth standards into single antenna geometry is the symmetry introduce by the Bluetooth element.

Remark: A small planar,low cost,dual-Band,easy to manufacture integrated Bluetooth/UWB aantenna is given in this paper. The antenna achieves dual band operation and it will be constructed on other types of microwave substrate with appropriate scaling.

[6]Jobin Kurian,UpamaRajan M.N, Shinoj K. Sukumaran. "Flexible Microstrip Patch Antenna using Rubber Substrate for WBAN Applications."

Proposed Method: This article offers the information about the design of patch antenna by the rubber as a substrate.In this case it also deals with the main method of use of natural rubber and the natural rubber with filler materials added as a substrate of designing of the patch.

Remark: The primary approach to use natural rubber and filler added natural rubber as the substrate for patch antenna. Some automatic properties of the substrate makes the antenna highly stretchy and highly effective. This newly designed antenna can be used for WBAN applications. The designed antenna works at 2.45 GHz, the centre frequency of ISM band.

[7].Steven E. Morris, YakupBayram, Lanlin Zhang, Zheyu Wang, Max Shtein, and John L. Volakis " High-Strength, Metalized Fibers for Conformal Load Bearing Antenna Applications" IEEE transactions on antennas and propagation, vol. 59, no. 9, Sept 2011

Proposed Method: It proposed the use of great strength, metal-coated Kevlar yarns to flexible, conformal, and load-bearing antennas for an developing class of applications highlighting multiple functionality. Particularly, here we presents a unique and quantitative analysis of many number of properties of the conductors as load-bearing materials in stress, weight ,and shape-critical applications, suggesting advantageous electrical conductor configurations to be metal-coated, Multi-filament, high strength fibers. Then we describe the fabrication of highly conductive metal coated Kevlar yarns, their mechanical and electrical properties, and the weaving of a flexible stretchable, volumetric spiral antennas. Then the higher frequency response of the antenna is found to similarity that of a traditionally made antenna comprised of electroplated a rigid ceramic substrate.

Remark: Here we present a new technology wherein high strength metal-coated Kevlar yarns were woven into polymer-ceramic substrates for conformal, load-bearing antenna applications. With the constructed volumetric spiral antenna using metal coated, twisted yarns woven onto a polymer-ceramic composite, we found that the woven spiral antenna exhibited similar performance characteristics to those of a traditional antennas at high frequencies. Woven antenna performance suffered at low frequencies due to relatively higher resistive losses of the coated yarns, suggesting that further research is needed to optimize conductivity of the yarns for low frequency applications. These results further suggest potential broader benefits to energy harvesting or lighting applications in the DC regime using conducting fibers.

III.BLOCK DIAGRAM

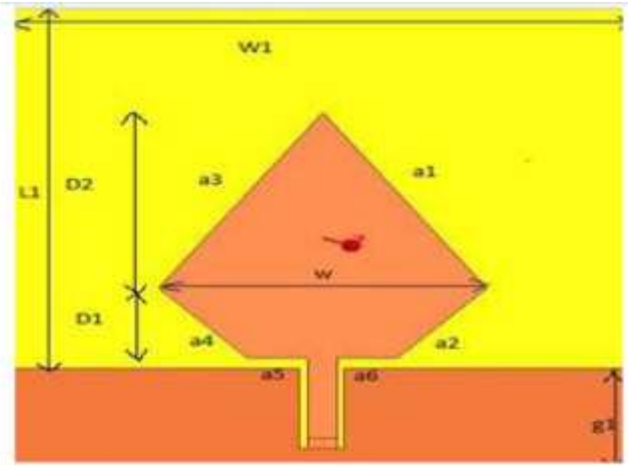

Fig 1. Block diagram of UWB Antenna

The antenna, shown in Fig.1 contain of 1mm thick FR4 substrate which has a relative permittivity of εr= 4.4 and a loss tangent of 0.02. The substrate transverse sizes are 42 × 46 mm , and there is no ground metallization under the radiator for proper operation. The UWB element of rhomboidal geometry is answerable for the 3.1 10.6 GHz UWB band. The design of the UWB rhomboid antenna starts with choosing D1 and D2. D1 and D2 are critical sizes associated with the upper and lower working frequencies of the antenna. Accordingly, D1 and D2 are selected to have a reasonable return loss at f_{min}=3.1 GHz and f_{max}= 10.6GHz which are the lower and upper ends of the UWB band. Good starting points for these sizes considered are as follows:

$$D1 \cong \frac{\lambda_{e,f_{max}}}{4} \quad (1)$$

$$D1 + D2 \cong \frac{\lambda_{e,f_{min}}}{4} \quad (2)$$

Where λ_e is the actual wavelength for the radiation mode in the FR4 substrate with the operative dielectric constant (ε_{eff}= 2.7 for the 1mm FR4 substrate), $\lambda e, f_{max}$ and $\lambda e, f_{min}$ are the actual wavelengths at the upper and lower UWB frequencies, respectively. Using above equations, designed values of D1 and D2 are 7mm, 17.5mm respectively. And the width of the patch can be selecting for desired return loss pattern.

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Table 6.1.Optimised antenna dimensions (in mm)

a1	a2	a3	a4	a5	a6	g1	W
20.7	9.6	20.7	9.6	4	4	10	22

IV.RESULT

S11 Vs Frequncy:

VSWR:

Schmitt Chart-

Difference Between Tested and Simulated Results:

Sr. no	Parameters	Simulated	Tested
1.	S Parameter	5.6327	5.7394
2.	VSWR	5.6644	5.6555
3.	Gain	4.75db	5.50db
4.	Reflection Coefficient	-10.01	-19.25

Hardware Result:

V. CONCLUSION

The UWB antenna is used for applications in WBAN, which is the current revolution in wireless sensor networks. Such antenna operates from 3.1-10.6 GHz, which is a candidate for WBAN operation. The flexible nature of the antenna makes it convenient for the use as a body worn antenna for WBAN. For on-body and off-body communications, IEEE802.15.6 specifies both narrowband and wideband frequency areas, such as industrial, scientific and medical (ISM) at 868 MHz (in the EU), 915 MHz (in the US), 2.4 GHz (in the EU & the US) or UWB at 3.1- 10.6 GHz.
In this paper a triangular shape microstrip patch antenna is designed which is basic shape of our antenna, & results are obtained in terms of different antenna parameters like VSWR, Reflection coefficient, Generated E & H field along with current distribution.

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