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On The Problems And Design Of Wearable Antennas

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Abstract-Wireless Body Area Network (WBAN) requires only a minimum amount of drive procedure with small array message and wide volume is obtainable by Ultra-Wide Band Technology. The humanoid physique presence carries tremendous difficulties for the plan of the propagation model as well as the wearable antenna in this system. To start with, the combination amid the wearable aerial and the humanoid physique must be considered even within the preliminary stages of the layout, with a purpose to be able to cope with each in all likelihood degrading performance of the antenna due to physique and the probability of revaluation for the physique. Later, the transmission medium of the Wireless Body Area Networks is controlled through the non-stop motion of the human body, as a result of the dissipation of the electromagnetic waves at different intervals. Many scholars are involved in the above subject then certain considerable development has been completed lately. The present article recollects today's consequences in the zone of aerials fixed in the physiques, transmission medium and then individual software in Wireless Body Area Network systems. This review discloses the major improvements of physique aerials involved by the part of fixable in the physiques and non-fixable in the physiques Ultra-Wide Band method then their applications in the Wireless Body Area Network device and methods for reducing SAR in them.

Keywords: Specific Absorption Rate, Ultra-wideband Antenna, Wearable Antenna, On-Body Antenna.

I INTRODUCTION

Ultra-wideband communication offers a few focal points with regard to ordinary narrowband ones, such as higher data rates and expanded resistance to interference due to lower power spectral density. WBAN has picked up critical interest due to the wide variation of conceivable employments, such as security screening, entertainment, health care and medical monitoring [1].Due to its reduced exposure in terms of electromagnetism, WBAN has earned a name in the field of Wide-Band technology which could be used for commercial purposes. Having said, designing or modeling a wearable antenna for these applications is ultimately difficult exceptionally for the applications related to ultra-wideband function.[2] The primary angle in the design is the association of the human body and antenna which affects the performance parameters of the antenna and possibly results in high electromagnetic sensitivity. The possible issue is the deformation of antennas when embedded on the human body.[3] The durability of the antenna plays a key role when used in various environments which involve temperature, humidity, etc. Moreover, WBAN procreation channels stands out as compared to other conventional channels. [4] This is due to the constant change in indoor and outdoor environments. Complications may possibly occur in multipath phenomena due to the continuous movement in users. [5] This phenomenon of absorbing radiation has many ill-effects on humans. If the SAR (Specific absorption rate) crosses the maximum threshold of 1.6 watts per kilogram for 1 gram or 10 grams of human tissues, it may cause adverse effects such as head ache, sleep disturbance, fatigue, and dizziness. Hence it is important to maintain the SAR standards below the FCC standards. [6] This paper is structured to analyze antenna design to assess distinctive highlights that affects the core efficiency standards of antenna, particularly bending related conditions, closely-packed sizes, Ultra-Wideband coverage, and omnidirectional radiation patterns in accordance to their measurements and Specific AbsorptionRate [7]

II WEARABLE UWB ANTENNAS FOR OFF-BODY COMMUNICATION

A Uwb Off-Body Antennadesign

Attributable to its simple design, wide data transfer capacity, and reasonable radiation productivity, the topology of monopole planar antenna is generally utilized in the communication systems of UWB and delegated the underlying topology utilized for the one which is using fixable. [8] Quickened advancement in cordless technology consistently needs the requirement for the development in the design of antennas. Especially, after Federal Communication Commission was assigned, the recurrence ranges between 3 GHz to 10.5 GHz in practice lacking permit. An imaginative three-sided half-circle monopole reception apparatus took care of with the help of coplanar waveguide in the usage of very great Ultra-Wide Band drives. [9] Planned design utilizes the flame retardant with an order of base 4 with chosen measurements, which is appeared in 1st illustration. Planned design is effectively tried then developed including wide transfer speed greater to 126 % therein Ultra-Wideband recurrence range secured reach between 4.9GHzand25.0 Gigahertz including sensible intelligent constant, addition productivity close by the radiation designs specified by scope by Federal Communication Commission, Figure1. Shows the Schematic of UWB antenna.

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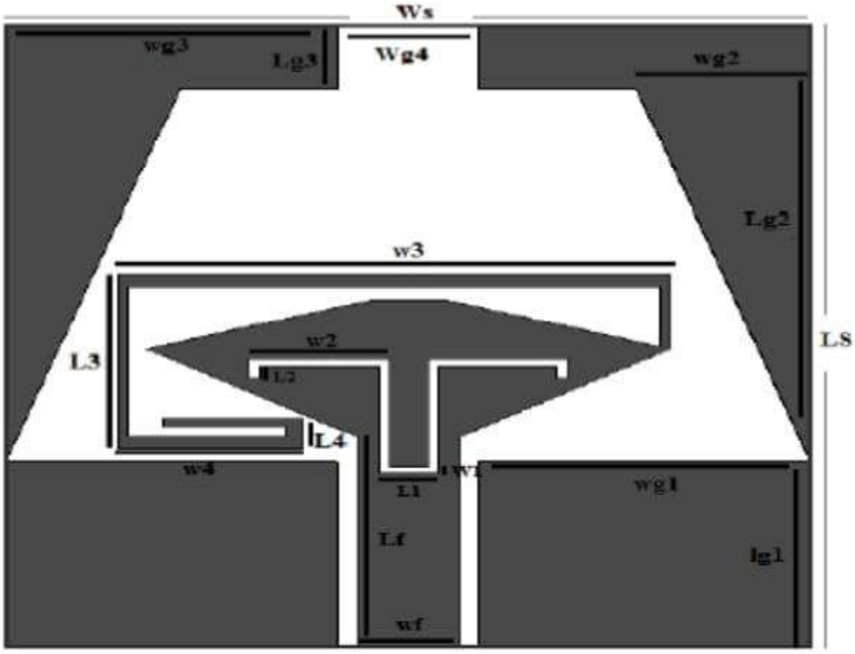

Figure 1: Schematic of UWB antenna.

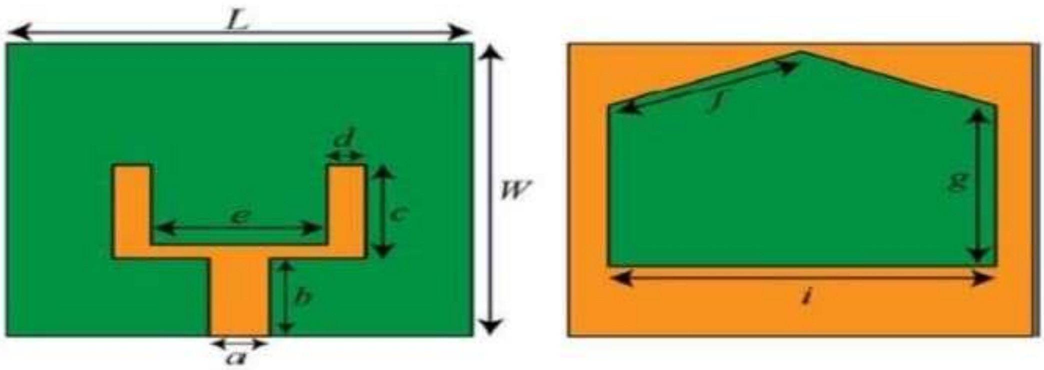

Figure 2:UWB antenna schematic.

The design which is made of lightweight planar UWB antennas is portrayed for isolated usages. For arriving at a more extensive impedance data transfer capacity, the antenna was introduced in flame retardant with an order of 4 along εr is equal to 4.3, then height of 0.15cms, ordering aerial little shape along the complete component as portrayed by illustration 2. [10] Planned aerial radiates equally in all directions having a recurrence range of 2.8GHz to 14.9GHz along more than 10 GHz transfer speed. As to the estimation of electromagnetic radiation (EM), affectability for humanoid skins is recognized whenever the antenna is situated close with stimulating layout of phantom. Investigation conducted demonstrated about SAR esteems distant beneath constraint by Federal Communication Commission along with additional well-being norms, delivering the proposed antenna a sensible decision for remote uses ofshort-range, Figure 2. Shows the UWB antenna schematic.

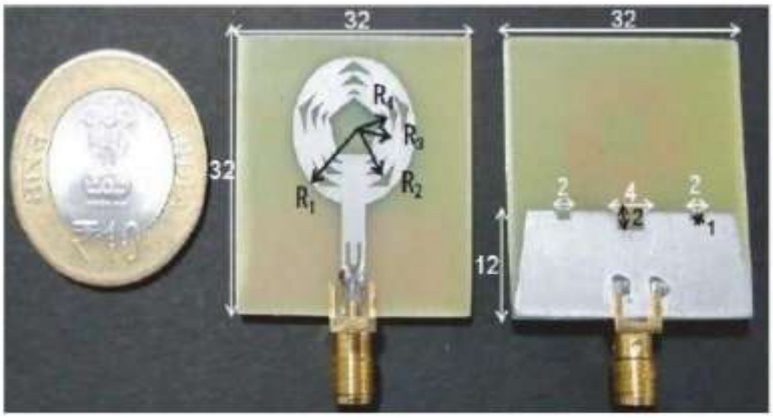

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Figure 3: Prototype with its dimension

Also, the UWB antennas are planned and manufactured by Rokunuzzaman utilizing a modest field retardant substrate with an order of 4, εr is equal to 4.3 and height is equal to 1.60 millimeters in request to assess Ultra-wideband radiation yield close to the head phantom of Hugo with the measurement of antenna portrayed in Figure 3. The antenna capacities over a recurrence range of 3.1GHz – 6.7 GHz surveyed regarding the Electric field, Magnetic field infiltration, Specific Absorption Rate and intelligent coefficient. The outcomes affirmed that the force spread at the lower Ultra-wide band recurrence zone present internally in the human head is more practical.

III GROUND PLANEANTENNAS

A major drawback of planar monopole antenna is that it doesn't provide conductive shielding in-between the human body and antenna while being easy and quick to design. While the issue isn't fathomed immediately, approaches have been proposed to decrease the deterioration caused by antenna-body proximity. Antennas with rear ground planes seem an optimal solution to avoid human body interfering with the output of wearable antennas.The most utilitarian and easiest topologies for a common topology is microstrip, which contains ground plane, radiating area and dielectric-sheet. A microstrip developed on textile antenna which composed microstrip to follow the IEEE WBAN ultra-wide-band properties is analyzed and designed by Samal. With antenna dimension of (42 x 39 x 3.34)mm.

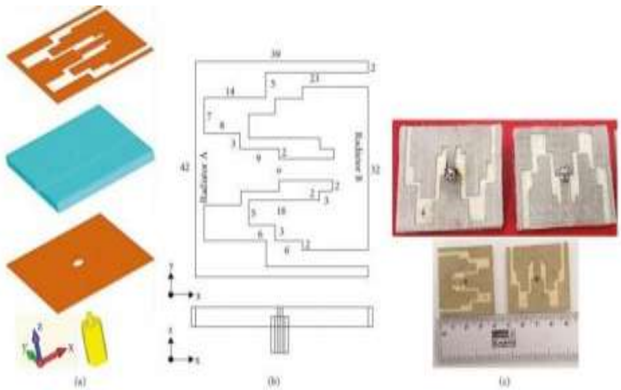

Figure 4: Design of the proposed antenna.

The ground plane reduces the antenna's exposure and interaction with human body, which provides protection. Furthermore, the antenna operates in 5 other high band channels along with the ultra-wide band (UWB) range, showing an additive bandwidth range of 3.4GHz.The antenna analysis results functionality in both free space and the human body. Ultra-wide band antennas are light weight, provide reasonable radiation pattern for numerous radiation patterns and low cost. Yimdjo Poffelie, Figure 4 shows the Design of the proposed antenna.

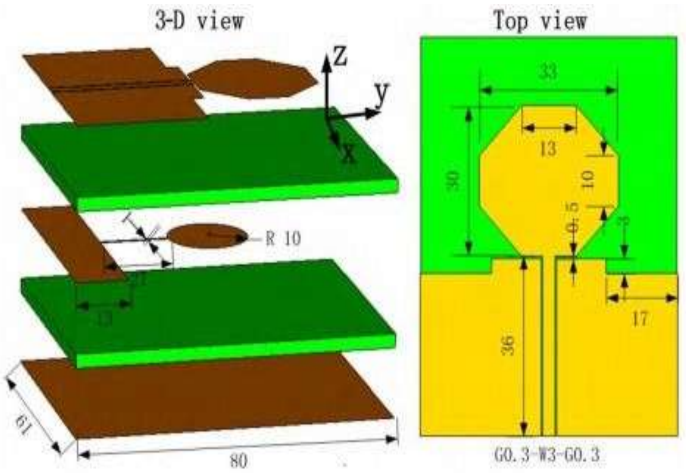

Figure 5: Design of the antenna with low back radiation

Proposed an all-textile antenna design with high fidelity and back radiation. The fidelity measured each on the human body and free space was over 93%, Figure 5 shows the Design of the antenna with low back radiation

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IV UWB ON-BODY COMMUNICATION DESIGN

Ultra-wideband technologies are widely utilized in wearable applications. When these antennas are used in Wireless Body Area Network system. The radiation pattern must be omnidirectional and the direction must be longitudinal when considered to the human body. Therefore, a monopole will be the best suitable choice for this system. One important thing to be noted is the height should be decreased accordingly and the bandwidth should be enlarged in order to match with the proposed application.

An UWB loop antenna was proposed by Tommi Tuovinen. The proposed antenna is compact and meets with standards of FCC. The antenna holds good for the use in on body Wireless Body Area Networks applications. The main purpose of this antenna model is to test how the thickness of the human body's external or top most tissue layers affect the antenna characteristics. Also, it operates in the range of 3-10GHz without using a groundplane, Figure 6shows the Antenna Model

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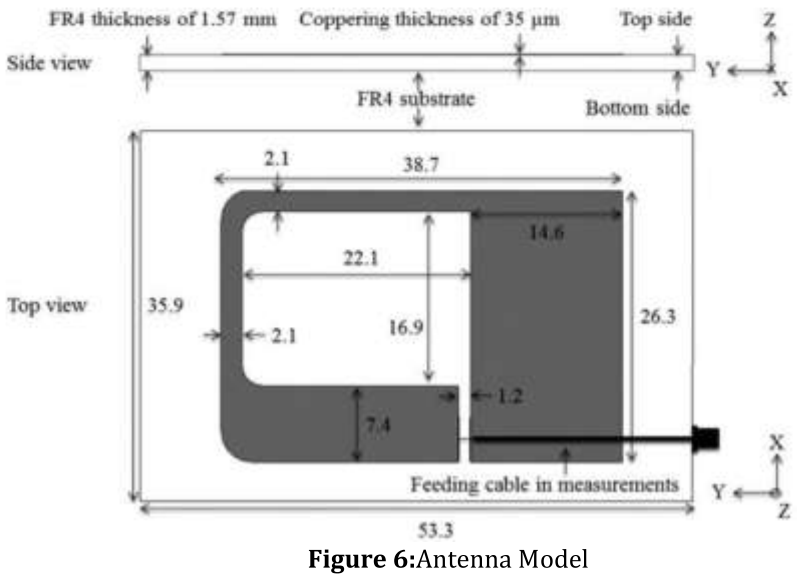

Figure 6: Antenna Model

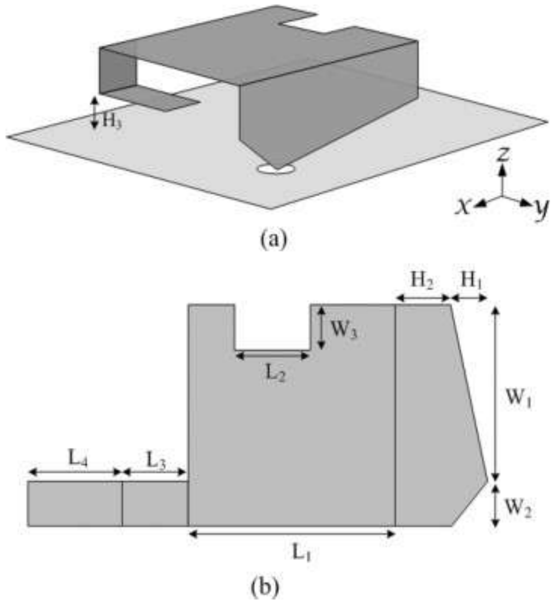

Figure 7:(a) Schematic of the antenna. (b) Antenna unbent into planar structure.

The antenna design in Figure 7 is designed by Cheng-Hung Kang.This antenna is compact and matches with the requirements of Wireless Body Area Networks. The designed antenna shows lower SAR values due to the bevel structure used. Ultra-wide band is achieved with the help of the folded strip. Hence, it is suitable for WBAN applications [8]. The dimensions of the proposed antenna are H1 = 4mm, H2 = 6mm and H3 = 3mm, W1 = 20mm, W2 = W3 = 5mm, L1 = 22mm, L2 = 8mm, L3 = 7mm, L4 = 10mm.

V SAR REDUCTION

An idea was proposed by MengJun Wang. In order to decrease the large SAR values. The antenna designed in this journal is flexible, compact and thin because of the metamaterial used. Because of this metamaterial substance the SAR value is drastically reduced and the antenna gain is elevated.

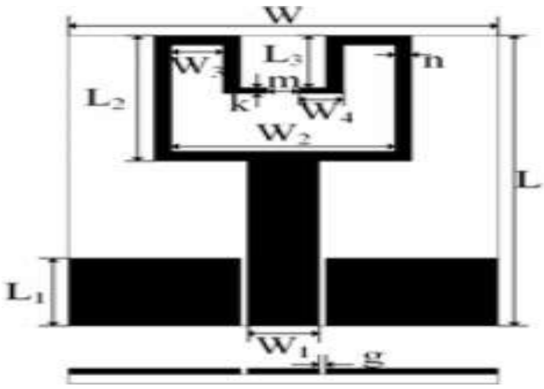

Figure 8. Design Model of Antenna

The antenna designed by combining the metamaterial was tested which shows it to be flawless and perfect for wide range of uses.Another efficient way of reducing SAR is done by using a planar inverted-F antenna (PIFA) with an electromagnetic band gap structure. In case of dielectric, PIFA and EBG unit cells are to be designed first. By using the head phantom model of human, the location of the antenna including the height and number of EBG cells are to be studied. By this, we can improve the SAR reduction effect. EM waves generate thermal effects in some frequency bands. These are to be taken into effect to inspect the event of the well-being related difficulties brought about by the cell phones, Figure 8. Shows the Design Model of Antenna.

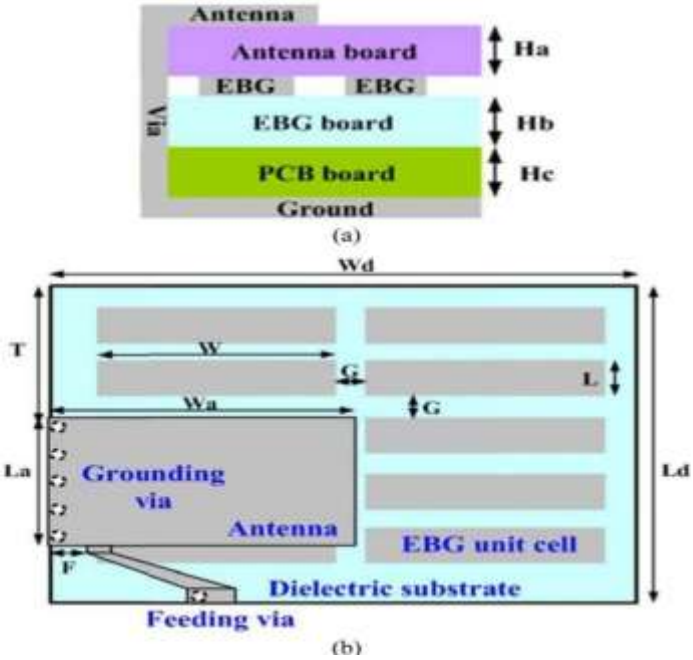

Figure 9: (a) and (b) Design schematic of antenna.

At first, the electromagnetic band gap structure between the antenna layer and the PCB is to be planned while designing the multilayer PIFA structure for reducing the specific absorption rate, Figure 9(a) and (b) Design schematic of antenna. The radiation patterns, S11 parameters, SAR values, and total radiated power values are obtained by exploring the PIFA along the EBG. With the help of the EBG structure, the human body is secured from harmful Electromagnetic fields.

VI CONCLUSION

UWB innovation has created a wide range of opportunities for WBAN networks which provides an economic solution in Body Area Network Applications (BAN). Ultra-wide band innovations are widely used in day-to-day applications. In this review, wearable UWB antenna prototypes and its employment for both on-body and off-body communication methods and SAR reduction are investigated. Since SAR Reduction plays a key role in WBAN two methods have been analyzed.

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