Flexible CPW-Fed Tuning fork-shaped Patch Antenna for UWB Applications

K. S. Ravi Kumar [1] , Dr K P Vinay [2] , S.G.S. Vardhan [3] , T. Yaswanth [4] , S.Yaswanth [5] S. Surendra [6]

Department of ECE, Raghu Engineering College (A), Visakhapatnam, India[1]
Department of ECE, Raghu Engineering College (A), Visakhapatnam, India [2]
Student of ECE, Raghu Engineering College (A), Visakhapatnam, India[3]
Student of ECE, Raghu Engineering College (A), Visakhapatnam, India[4]
Student of ECE, Raghu Engineering College (A), Visakhapatnam, India[5]
Student of ECE, Raghu Engineering College (A), Visakhapatnam, India[6]

Abstract

The main intention of this project is to design an ultra-wideband (UWB) and wireless band area network (WBAN) antenna for future Internet of Things (IoT) applications. Antenna is built in a full ground plane and constructed on a Y-shaped Patch fed using a co-planar Waveguide (CPW) line. This is designed using two different types of substrates, they are a 2-mm-thick felt textile and 2mm thick rogers RO4350B. By changing its critical dimensions, The Parametric analysis other antenna is performed.

And we can monitor the parameters of antenna such as efficiency, bandwidth, radiation pattern, and gain for both substrates.The redesigned Ground material radiation patch is provided by the wearable fabric UWB antenna in the frequency range of 3.1 GHz to 10.6 GHz.

Keywords

Wireless Body Area Networks (WBANs), Ultra-Wideband (UWB), Co Planar Waveguide (CPW).

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1.Introduction

Future 6G architecture are designed as a very dense, diverse, adaptable, and unified technology with outstanding bandwidth availability for practically infinite growth. WBAN is a future technology that has been merged with IoT-based applications and offers a plethora of benefits in the medical surveillance system. It is proposed to integrate the new wireless access network with Radio over Fiber (RoF), allowing for high-speed data transfer. Smart wearable gadgets capable of collecting data, manipulating actuators, interacting with external devices, and wirelessly charging are generated as a result of such applications. Wearable textile antennas are one such example of this revolutionary future technology, and the incorporation of an electronics inside smart textiles has been identified the key enabler. The smart textile will be included.

The major advantages of textile antennas are described as follows: lightweight, low cost, and robustness, very low maintenance, and unnoticeable in military applications. Textiles are utilized as substrates and conductors. Low relative permittivity (εr), low loss tangent (tan(δ), and thin thickness (h) all result in reduced surface wave losses and increased antenna performance.

2.Literature review

A WBAN creates a wireless communication channel by linking sensors, actuators, and IoT nodes on the human body, clothes, or beneath the skin. Wearable antennas can monitor vital signs, oxygen levels (Oximetry), and stress levels, among other things, in people of all ages, athletes, and patients.

The Coplanar Waveguide (CPW) structure is a typical approach for stimulating additional resonance are come up with the wideband characteristics in the antenna design. In 2002 Federal Communications Commission (FCC), maximum performance for portable antennas requires a minimum bandwidth of 500 MHz from 3.1 to 10.6 GHz. In WBAN, more precisely as a medical sensor for blood pressure, glucose levels, electrocardiogram (ECG), etc., UWB is preferred because it requires continuous short-range signals with high transmission rates, while 5G has high data speeds. It is important to avoid interference from multipath to resist fading. In addition, the market favoring small wireless device systems, research on flexible antennas is the main focus.

3.Methodology

In th The following subsections outline the antenna design workflow. Antenna design and its optimization before production is part of the scope.The subsections below go through the specifics of the materials utilized and the stages involved in this research project. This design's approach, which also included the appropriate design and unit cell.

3.1 SELECTION OF SUBSTRATES

As it is a wearable device in the WBAN system, the material chosen must offer high flexibility, wide bandwidth and mechanical resistance.As an outcome, the RO4350B, Felt, and denim textile materials were investigated. Felt substrate with r = 1.45 relative permittivity, tan = 0.045 loss tangent, and t = 2 mm thickness. The relative permittivity for RO4350B substrate is r=3.65 with the thickness of

other material, t =2.00 mm. The suggested antenna is made out of a 2 mm thick Jeans (Denim) substrate with a dielectric constant of 1.65. The antenna is 40.1 mm in length and 42.2 mm in breadth. The antenna's deployment position influences the substrate material choice. . The antenna has no direct body contact and the entire module is housed in a plastic housing. In such applications, the antenna is printed on the same board as the sensor or transceiver, so it can be used on any board. For sports applications, certain wearable antennas are embedded into wireless sensors.

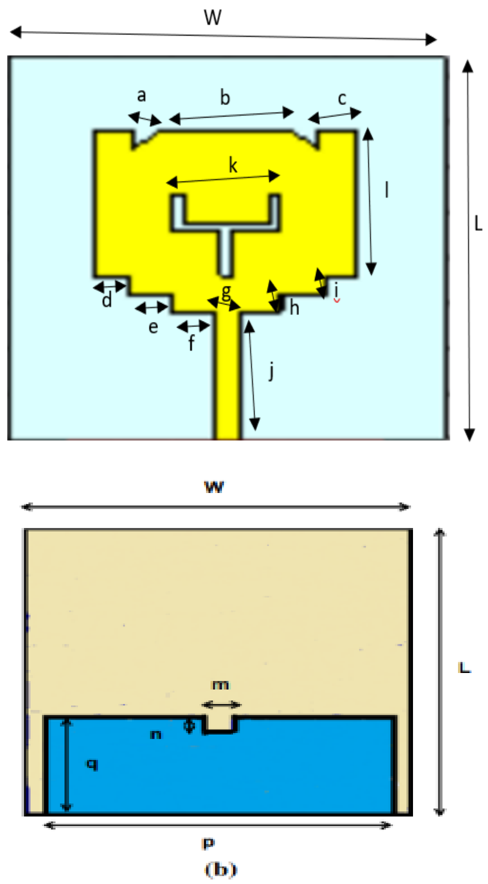

Figure 1. (a) Antenna design and **(b)** Ground and Substrate

The designed antenna was created using the CST
simulator's optimization method.

Table 1. Parameters of an antenna.

Dimensional notation	Values	Dimensional notation	Values	Dimensional notation	Values
L	42.1	E	4	k	5
W	40.1	F	3.75	l	16
a	2.6	G	2.5	m	3
b	20.8	h, i	2	n	2,1
C	4	J	14	p	36
D	3.1	ɵ	60	q	14

4.RESULTS AND DISCUSSION

4.1 Parameters Assessment :

To achieve the requisite frequency ranges, CST was used to replicate the Y-shaped antenna in slotted UWB within an integrated CPW antenna. The S11 and bandwidth improvements are shown on the output forms and in Table 2. The utilization of felt and jean is to improve bandwidths, gain, and radiation diagram , whereas in usage of the RO4350B and guage the viability of textile materials in the conclude applications. The simulations shows that the antenna with jean and felt substrates material features a bandwidth of 9GHz and 8GHz, respectively, compared to 5GHz with RO4350R material, indicating a 400% bandwidth gain. The S11, when combined with denim felt and RO4350B substrate materials, achieves the required frequency range of 3.1 to 10.6 GHz (UWB range).

The radiation diagram is vital to analyse the antenna is a fundamental material of the WBAN system. As a result, utilising denim and felt materials, the antenna's performance is projected through the better way, Particularly in terms of the radiation diagram. In greater the bandwidth, the more electromagnetic (EM) waves have reflect in the front. This property features a substantial impact on an antenna's operating frequency, gain directive, and efficiency. Figure 3 depicts the antenna's radiation diagram at 8GHz. An antenna with denim and felt substrate materials have a far better direction than wth the RO4350B substrate material.

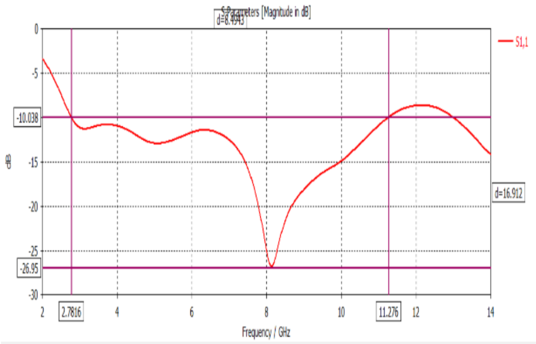

Figure.4a. S11 of an antenna with a jean substrate.

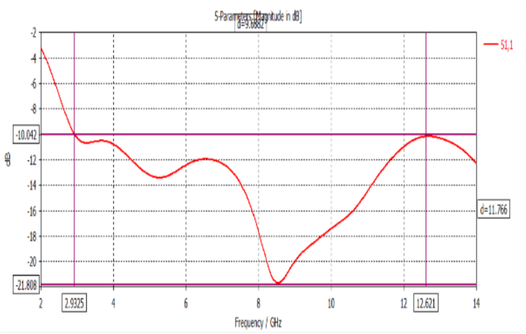

Figure.4b .S11 of the antenna with Felt substrate.

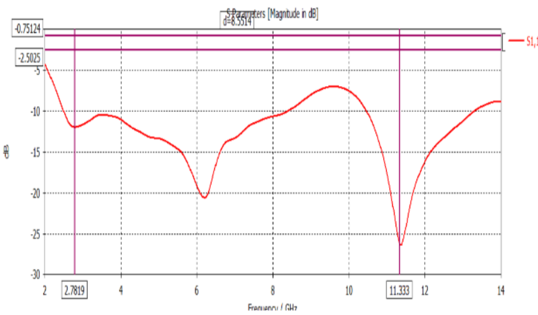

Figure.4c. The S11 of the antenna with RO4350B substrate

	ro4350b	felt	jean
Frequency <-10dB (GHz)	2.6 - 8.4	2.9 - 12.6	2.7 - 11.2
Bandwidth (GHz)	5.7	9.7	8.5

Table.2. Bandwidth for RO4350B, Felt and jean Substrate Material

.CONCLUSION:

This study describes a Ultra Wide Band slotted Y-shaped antenna with Co-Planar Waveguide feedline. On three substrate materials: RO4350B, felt, and jean and this antenna is tested in terms of important perform the factors as frequency range, gain, directivity, and antenna efficiency. The antenna with a felt and denim substrate has 4 times a bandwidth and reflection coefficients as antenna developed in the RO4350B, but it has less mechanical flexibility.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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