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DESIGN AND DEVELOPMENT OF AN ANNULAR RING DUAL HEXAGONAL SLOTTED FLEXIBLE ANTENNA FOR ULTRA WIDE BAND APPLICATIONS

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ABSTRACT

The ultra-wide band antenna that is described in this study is one that functions in that category. Jeans, which are naturally flexible, serve as the foundation for the antenna being constructed. Jeans were used as the substrate for the construction of this textile antenna, which was designed to reduce the amount of surface wave losses. This antenna is designed to be worn. It is possible to read the proposed antenna design as follows: the patch and the defective ground make up the design. A line feed technology is incorporated into the design of the wearable textile antenna in order to enable it to possess the capability of being energized. 149.96% is the impedance band width of the frequency band that extends from 4.0 GHz to 23.75 GHz, according to the findings of another discovery. In the course of the simulation, it was established that a peak gain of 4.764 dBi was accomplished at a frequency of 14.284 GHz. Following the observation of the radiation effect, this knowledge was found through investigation. The antenna that is offered has a large frequency range, which guarantees a broadband coverage. As a result, it is particularly well-suited for use in applications that involve UWB and the Internet of Things.

Keywords: Broad Band, Jeans Substrate, Gain, UWB, IoT.

1. INTRODUCTION

The term "antenna" refers to the metallic structure that is composed of conducting material that is used to receive and transmit electromagnetic waves, which are often radio waves, in order to communicate or broadcast information at the speed of light. The term "wearable antennas" refers to antennas that are designed to be worn and are developed with size augmentation using high frequency software such as HFSS and CST. Increasingly recently, the wireless communication industry has been boosted by the enormous expansion in antenna design. This has been accomplished by reducing the size of various communication systems, such as smart phones, laptops, tablets, and so on. As a result, researchers have been able to manufacture antennas with a compact design and high performance in order to make use of the limited space available in wireless communication systems [1-5]. Wearable antennas are mostly utilized inside a variety of wireless communication systems (WCS) and radio frequency systems related to biomedicine. These systems include cellular personal communication systems (PCS), satellite navigation, and a great deal of other instances of wireless applications [6-12]. As more time passes, the telemedicine business is also expanding, and wearable antennas are becoming increasingly important for mobile healthcare systems in order to ensure continuous monitoring of the human body. The biological material characteristics and the deformations that occur at various angles within the human body are responsible for bringing these processes to the forefront of attention. Therefore, UWB textile-based antennas have a wide range of applications that can be utilized for low power consumption, communication across short distances, and the transmission of high-speed data for the purpose of continual patient monitoring [13-18].

In recent years, the realm of body area networks has been increasingly encircling the body-centric communications that have emerged. With the rise in demand for the Internet of Things, the development of BAN devices has been sparked to speed the digital transformation of a number of different industries, including health, tracking and others. In addition to this, in order to ensure that there is no disruption in the factory's communication system. Not only is 5G the most empowering technology of the present day, but it also represents the downsizing of wireless systems, which is the technology that is developing at the fastest rate in the world. The adoption of textile antennas for a wide range of applications is encouraged by the fifth-generation technology [19-22]. In addition, wireless body area networks are used to locate and transmit the physiological data of users. As a result, these networks are dispersed throughout the human body. Furthermore, their applications have extended due to their durability, weight, and relaxing designs, as well as their ability to be miniaturized in size [23-25]. In addition, the long-range applications as well as the short-range applications and WLANs are driving the UWB towards the future.

The purpose of this work is to develop a novel tiny UWB wearable antenna that operates between 4.0 to 23.75 GHz while preserving a safe level of specific absorption rate (SAR). This is something that the human body ought to try to attain. In accordance with the specifications that have been specified by the IEC, this antenna has the potential to achieve a low SAR, which is advantageous for the safety of the user. The requirements that were described earlier are taken into consideration by this innovative antenna, which allows it to differentiate itself from additional antennas. These four unique sections make up the entirety of the article that is being distributed. A description of the introduction as a whole can be found in the first section of the article. The construction of the proposed antenna is discussed in section 2, which also includes the size of the antenna as well as various other considerations. In the third section, the optimization method, the results, and the explanation are divided down from one another. The final section of the work is summarized in Section 4, which is the final section.

2. ANTENNA DESIGN

To begin, the selection of the material is carried out in accordance with the requirements of the design, which encompasses both the material that conducts and the material that serves as the substrate. Because of the conducting material, the antenna is able to maintain a high level of efficiency because of its high electrical conductivity. Therefore, silver, gold and copper are the materials that the researchers favor the most when it comes to building the antenna. In essence, this section on material selection leads to the qualitative approach, which also includes certain quantitative values. It is necessary to investigate the electrical properties of the novel materials, such as the loss tangent, the dielectric constant, and the conductivity of the material. This will primarily lead to the quantitative approach of the research, which will incorporate some qualitative characteristics, such as the bending effect, thermal and robustness tests, humidity, and so on.

This diagram illustrates (Figure 1) the main stages that are included in the design process. The antenna construction is implemented using a denim textile substrate that has the dimensions Ws × Ls. This particular implementation of the antenna construction is employed. In order to complete the production of an annular ring patch, a piece of conductive adhesive copper tape is utilized. In order to achieve the goal of excitation of a basic patch, a microstrip line that has dimensions of LF x WF is utilized. Both the impedance matching and the bandwidth enhancement processes are dependent on a ground plane that has faults. To improve the impedance band-width of the suggested antenna, the ground plane has been given a partial configuration through the utilization of this concept. The ground plane is an essential component in this design, as it plays a significant role in improving the antenna parameters. In most cases, the ground plane is limitless; however, in the current design, a significant amount was eliminated, and as a result, we were able to achieve the desired improvements in bandwidth and directivity.

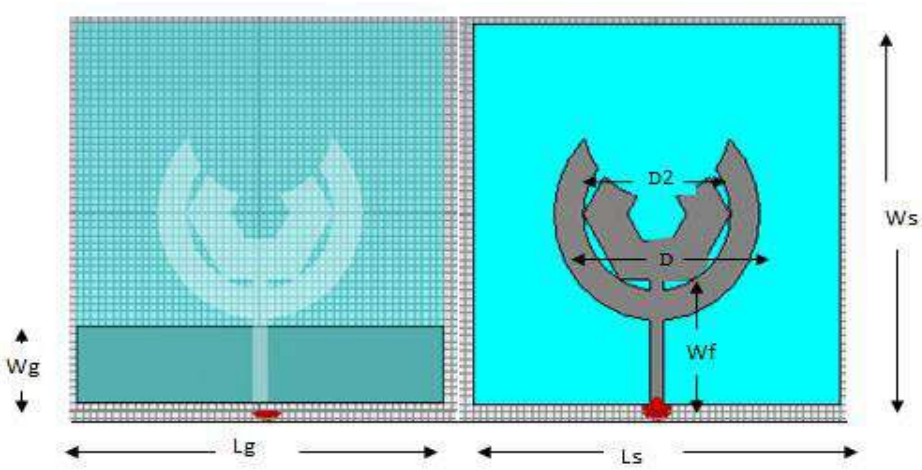


Fig.1. Ground plane and Patch of anticipated textile antenna

Table 1 Designed parameters of presented antenna

Parameters	Dimension
Dielectric Constant (Textile)	1.7
Ground Dimension ((Lg×Wg)	46.3 x 11.3 mm
Substrate Dimension (Ls×Ws)	46.3 x 52.6 mm
Patch diameter (D1)	28
Inner circle diameter (D2)	20
Feed Length (L_f)	2
Feed Width (W_f)	18.3

3. RESULTS AND DISCUSSIONS

In order to create a low-profile slotted flexible antenna design, as can be seen in Figure 1, the CST software was utilized. Figure 2 demonstrates that the antenna is able to achieve a wide bandwidth capacity of 149.96%. This is something that can be perceived. It is seen in Figure 3(a) that the flexible antenna that has been suggested has a maximum directivity of 4.764 dBi when operating at a frequency of 14.284 GHz. According to Figure 3(b) and 3(c), the directivities of right polarization and left polarization are 3.867 dBi and 3.867 dBi, respectively. The two dimensional radiation patterns at resonant frequency 14.284 GHz is shown in figure 4.

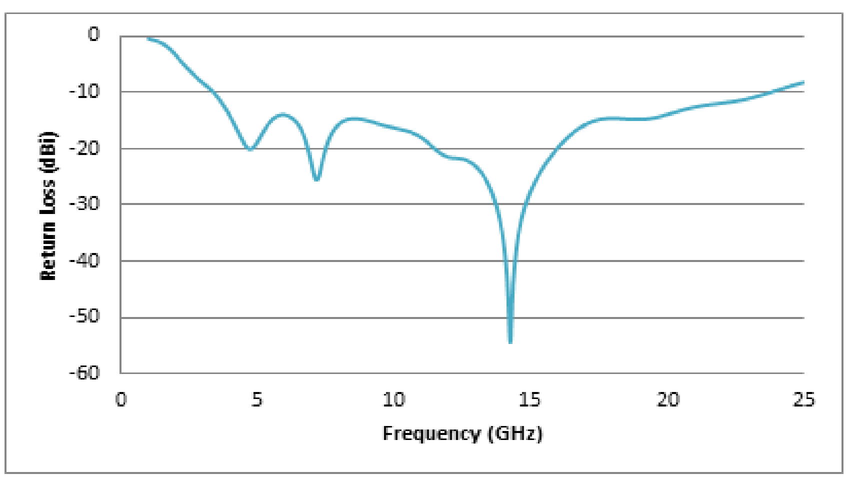
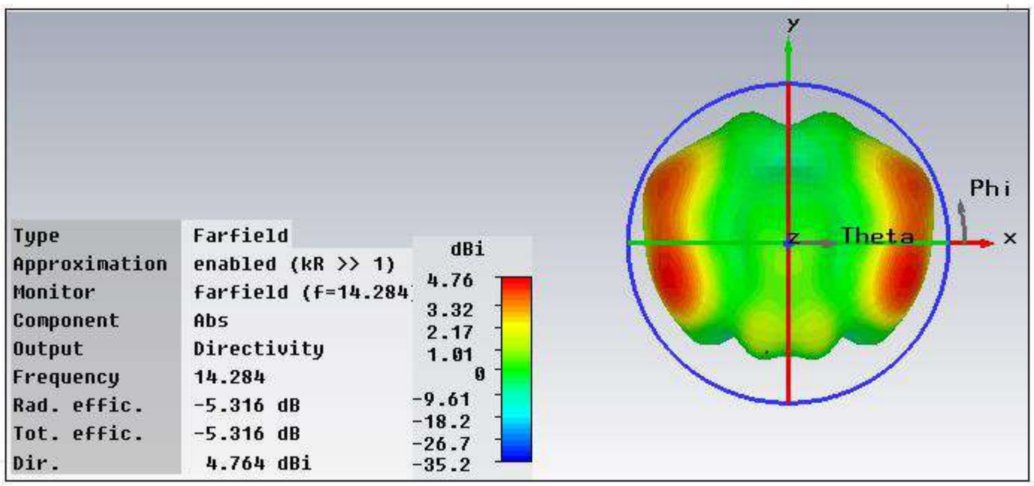


Figure 2 S_{11} parameter of proposed antenna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Rad. effic.
-5.316 dB
Tot. effic.
-5.316 dB
Dir.
4.764 dBi
dBi
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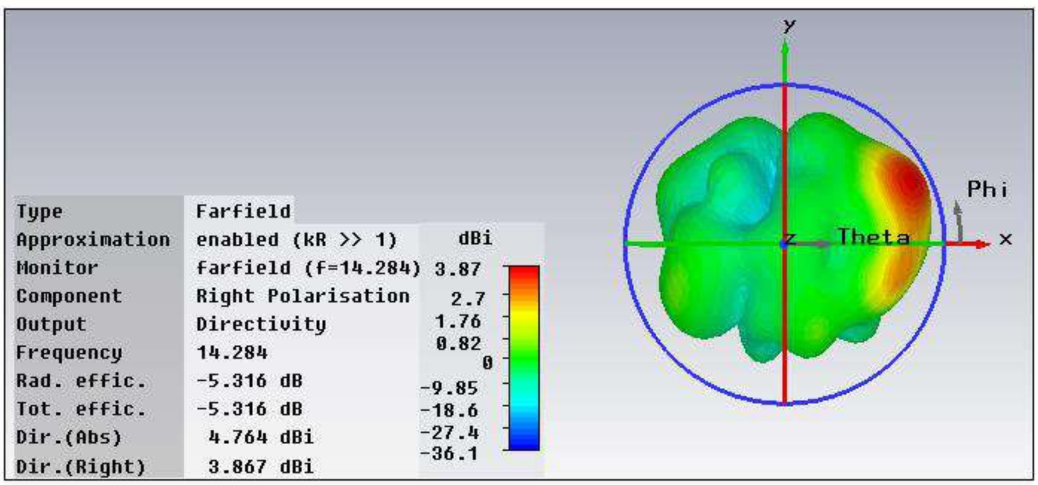
0
-9.61
-18.2
-26.7
-35.2

(a)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Tot. effic.
-5.316 dB
Dir.(Abs)
4.764 dBi
Dir.(Right)
3.867 dBi
dBi
3.87
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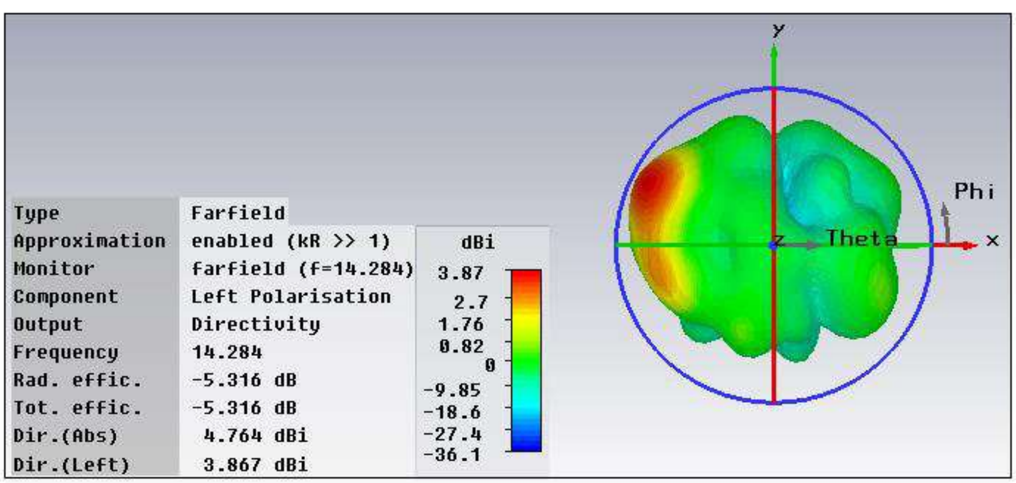
1.76
0.82
0
-9.85
-18.6
-27.4
-36.1

(b)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-5.316 dB
Dir.(Abs)
4.764 dBi
Dir.(Left)
3.867 dBi
dBi
3.87
2.7
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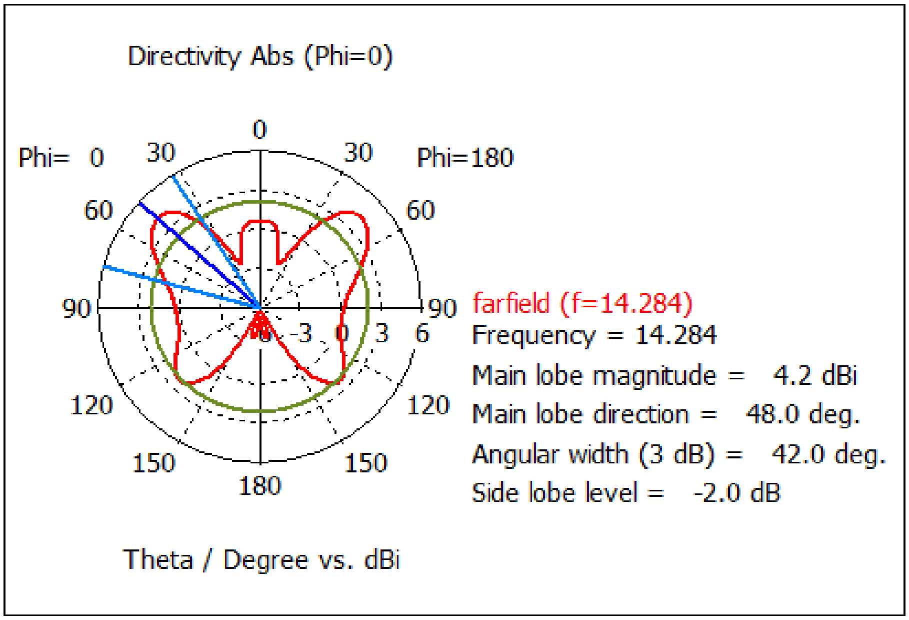
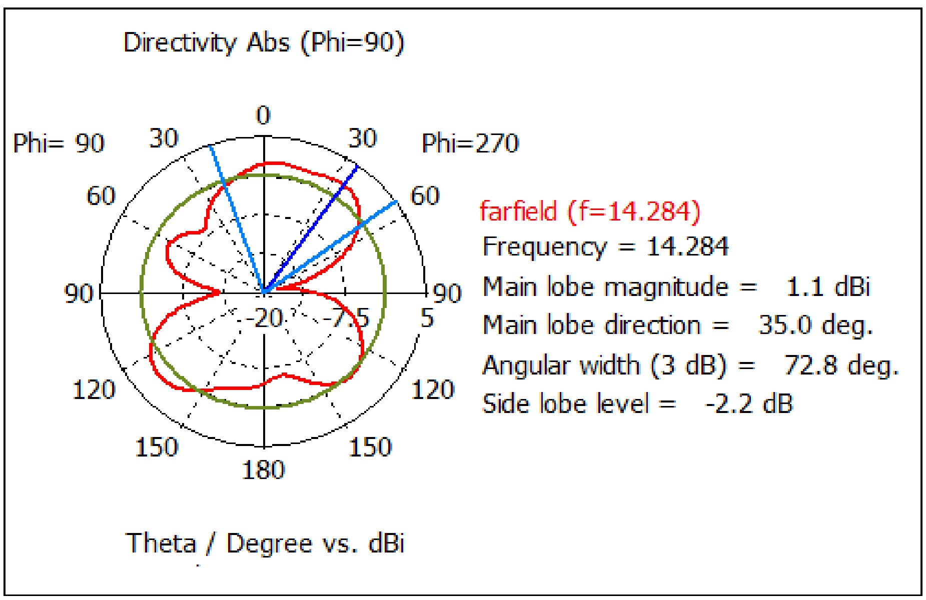
0
-9.85
-18.6
-27.4
-36.1

(c)

Figure 3 3-D Radiation pattern at 14.284 GHz





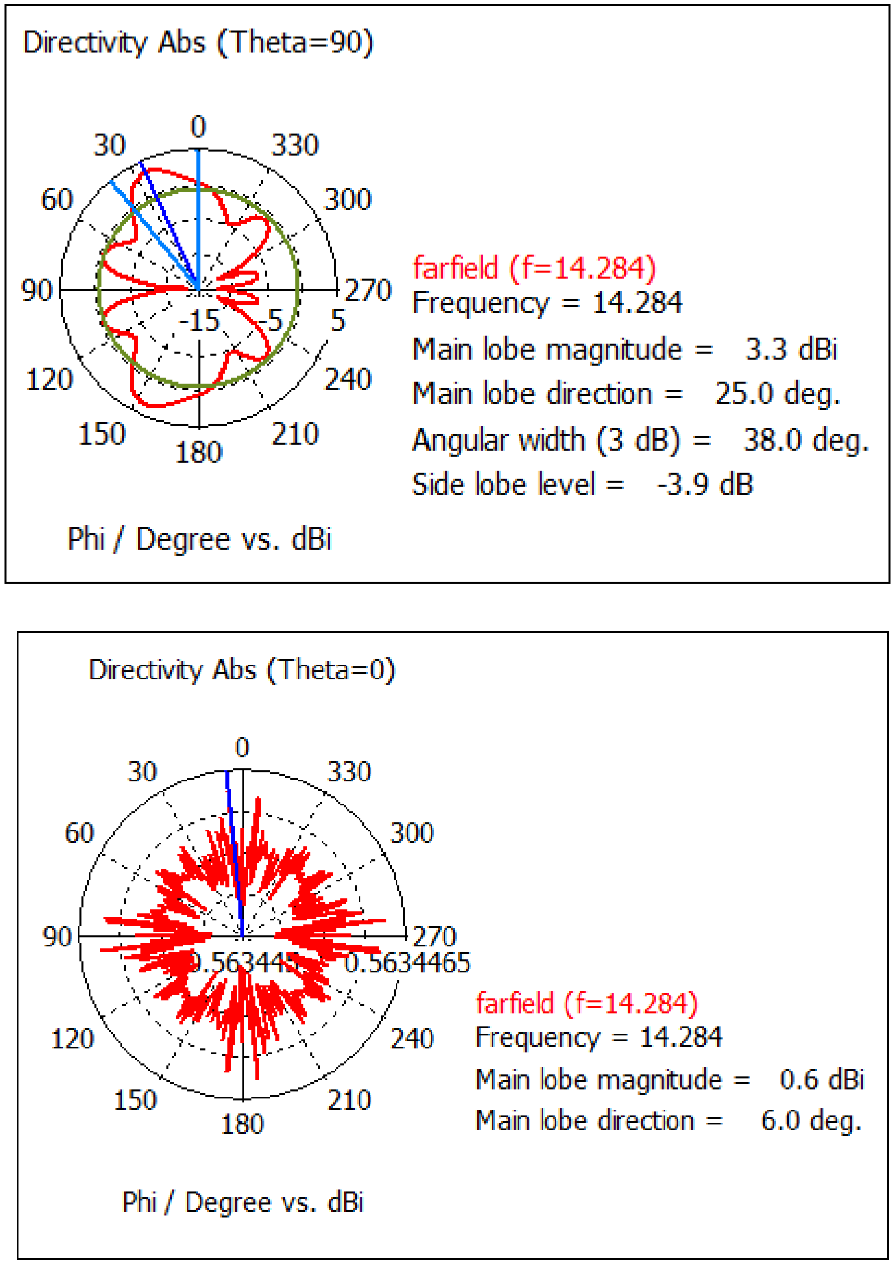


Figure 4 2-D Radiation pattern at 14.284 GHz

4. CONCLUSION

In this paper, we design and develop a novel broadband flexible antenna with rounded corners. Additionally, a semicircular slot is incorporated inside the patch in order to achieve a broadband width of 149.96%.It is possible to boost antenna gain by employing the partial ground approach, which allows for a broad bandwidth ranging from 4.0 GHz to 23.75 GHz. It has been found that there has been a significant improvement in radiation efficiency, radiation pattern, and directivity. As a result of its low size and wide bandwidth, the expected antenna is extremely well-suited for use UWB and Internet of Things applications.

AUTHOR CONTRIBUTIONS

Each of the authors has been responsible for the construction, study, and development of the methodology, as well as the analysis and the writing of the text.

CONFLICTS OF INTEREST:

The authors declare no conflict of interest.

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