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Novel Compact Dual Band Notched Ultra Wide Band Printed Antenna

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ABSTRACT
Wireless technology is one of the main areas of research in the world of communication systems today and a study of communication systems is incomplete without an understanding of the operation and fabrication of antennas. A simple and compact printed ultra-wideband antenna with dual-band-notched characteristics is presented. The proposed antenna is composedof a rectangular patch and a modified ground plane. The rectangular patch is etched onto a lossy FR4 substrate. A circular ring strip parasitizes the rectangular patch embedded by a U-shaped slot. Two Inverted-L slits and a rectangular slit are embedded onto the ground plane. Some bandwidth enhancement and band notched techniques are applied in the antenna structure for broadening the bandwidth and generating notches. The simulated and measured results show that the proposed antenna offers a very wider bandwidth ranging from 3.04 to 17.30 GHz, defined by the return loss less than −10 dB, with dual-notched bands of 3.30–4.20 and 5.10–
5.85 GHz covering the 3.3/3.7 GHz WiMAX, 3.7/4.2 GHz C-band, and 5.2/5.8 GHz wireless local area network systems.

Keyword
UWB, WPAN, W-USB**.**

1. INTRODUCTION
Compact size, low-cost printed antennas with Wideband and Ultra wideband characteristic are desired in modern communications systems. Dipole antennas have been popular candidates in many systems for their various advantages, such as Light weight, low cost, ease of fabrication, etc. Normal dipole antennas are with relatively narrow bandwidth; about 10% for VSWR of 2 This bandwidth problem has limited their application in modern wideband and multi-band communication systems. In addition, nearby objects easily detune the dipoles because of the limited bandwidth of operation. Recently, many monopole and circular shape based Planar antennas have been developed for UWB communication systems.

Various planar shapes, such as square, circular, triangular, and elliptical shapes, of monopole antenna are analyzed and reported. Compared with monopole based planar antennas, the design of ultra wide band circular ring type antennas is difficult because of effect of the ground Plane. For expanding the bandwidth of circular ring antenna, the arms are usually designed with fat wire or metal wide circular planar structure. Many designers have tried various ways to improve the structure of the traditional circular antennas, and many valuable results have been obtained. A trisul shape antenna is proposed in this paper. Its bandwidth is greater than 30% for VSWR < 2.Ultra-wideband (UWB) radio technologies draw big attentions considering the applications to the short range wireless communication, ultra-low power communication, ultra-high resolution radar etc., among them, the standardization of the UWB radio is ongoing under loss over ultra wide bandwidth: If there are mismatches both at the antenna end and the circuitry end, the overall dispersion characteristic is much degraded due to the multipath within the feeding cable. Constant directivity over ultra wide bandwidth: The variation of the directivity according to the frequency results in the ripples of the frequency transfer function in some citation direction. The dispersion characteristic is then degraded. There are two fundamental principles to achieve the broadband or UWB property of the antennas.

A CPW antenna which works at wide range of frequency has been analysed in presence of time domain by Shashanl Khagarot, et al. [1] here the author used very compact antenna for analysis and the patch is split to overcome the narrow band analysis. Here the author used two identical antennae for analysing the performance of Time domain analysis. Two conditions such as Side by side and Face to face orientations have seen in this work. Nooshin Valizade, et al. [2] proposed a model which works for both frequency and time domain of a novel antenna for ultrawideband applications. The antenna has been analysed with both frequency and time domain. The designed antenna performance will be operating at major bands covering x band and C band applications. In this work the author has concluded though it switches different domains the results shoes prominent in both the domains. Liang chen, et al. [3] demonstrated the broadband antenna and its measurement technique in time domain scenario. The pulse signals which are operating at resonating bands is analysed and researched. He designed and demonstrated how the variant of spatial angle in horizontal direction and demonstrated that the VSWR plays a key role for pulse signal characteristics.

Rafaela Neves De Barros Carvalho, et.al. [4] proposed how the far field radiated time domain characteristics. Using TEM coaxial horn. here the author developed by using analytical inversion of corresponding frequency domain. Which is obtained using geometrical optics principles and aperture method. The author observed that time domain radiated fields from omnidirectional dual reflector antenna has analysed using the different feeding techniques.

Yen-Sheng Chen, et al. [5] used optimization techniques for ultrawide band antennas to analyse its performance for both Time domain and Frequency Domain. Here the author used the system factorial design technique used to know the response of the pulses. The multi objective optimization is used for analysing the UWB planar monopole antennas.

Sherif R. Zahran, et al. [6] Proposed a conformal antenna which can be foldable having very thin material working at ultrawideband characteristics. Here the author used coplanar waveguide structure for conducting the analysis in both frequency and time domain. The simulated and measured results show very good agreement in this antenna type.

Susila Mohandoss, et al. [7] proposed an antenna which is low, flexible and robust planar antenna. The proposed antenna is flexible antenna and works for the ultrawideband applications and it is analysed using time domain analysis. The transmission coefficient and S parameters and group delay at various bending angles have been taken into consideration in this work for Time domain analysis.

A time domain based photonic crystal substrate patch antenna has been analysed by Hamidreza Azarinia and Ahad Tavakoli. [8] With the help of radiation patterns the author understands the antenna behaviour in time domain analysis.

The time domain inverse scattering multiplication is observed by Leopoldo A. Garza, et.al [9] in his research article. The approach is extension of forward to find gaussian pulse and effectiveness of antenna in time domain scenario is observed.

Hemlata Soni, et al. [10] Proposed an microstrip antenna which is working at ultrawideband antenna at notch band frequencies. The antenna has its own advantages to fulfil the requirements for all notch band antennas. The omnidirectional radiation patterns and time domain transient analysis with gaussian pulse have been observed in this work.

2. ANTENNA CONFIGURATION AND DESIGN

The geometry, parameters, top and front views for a planar Trisul -shaped antenna are shown in Figure 1. The antenna consists of trisul -shaped patch, 50• micro strip line and ground. The planar structure parallel to x-y plane; micro strip line is along the y-axis.

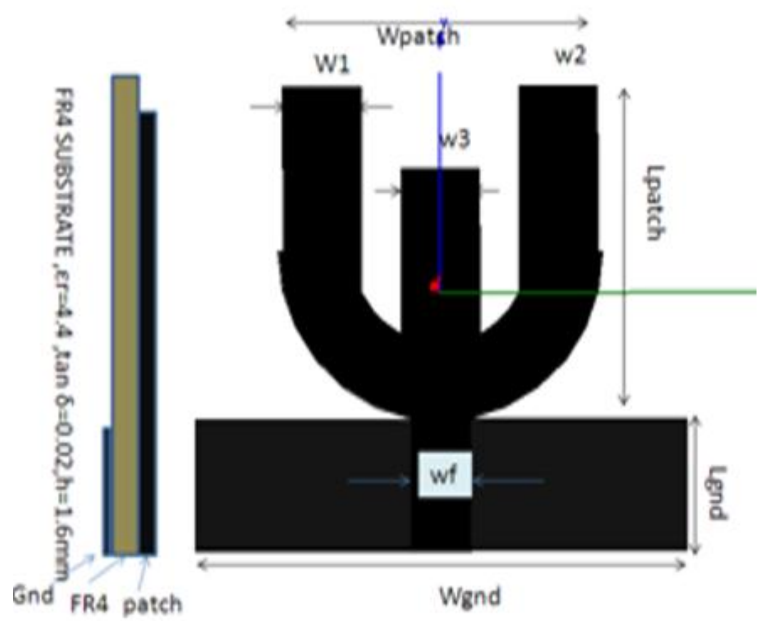

Figure 1: Geometry of basic trisul-shaped patch for UWB communication. (a). Top View (b) bottom View (c) Design geometry

Top view and front view of modified trisul -shaped patch antenna are indicated in figure 2. The proposed antenna is designed on a FR4 substrate with dielectric constant εr = 4.4 and height of the substrate is h =1.6 mm. The substrate has length L= 25mm and width W=25mm.The substrate is mounted on ground of 6.2 mm length and 25 mm width. The inner and outer dimensions are same as mentioned above, UWB technology has gained great popularity in research and industrial areas due to its high data rate wireless communication capability for various applications. As a crucial part of the UWB system, UWB antennas have been investigated a lot by researchers and quite a few proposals for UWB antenna design have been reported [12-20]. However, the design of those proposed papers are quite complex and tolerance of those special features/variables on the antenna design will be a big issue when it goes to mass production. Hence, this has motivated us to design up a very low complexity, low cost and compact antenna to cover a very wide frequency band including Satellite Digital Multimedia Broadcasting (S-DMB), Wireless Broadband (WiBro), Wireless Local Area Network (WLAN), China Multimedia Mobile Broadcasting (CMMB) and the entire UWB. In this case study, we present a very simple rectangular (no perturbation) planar antenna having the operating bandwidth ranging from 2GHz 12GHz by integrating various technologies into one compact antenna. We start with a simple circular monopole planar antenna fed by a 50Ω micro strip line with a truncated ground plane. Next, based on the study of the feeding position and current distribution, the antenna is designed to have the operating bandwidth covering the entire UWB, i.e. 3.1GHz-10.6GHz. Then, studies upon the size of the partial ground plane are done to increase the bandwidth towards the lower side of the frequency spectrum, rejecting the bands for WLAN (2.4GHz-2.484GHz) and CMMB (2.635GHz–2.66GHz). Thus the proposed antenna can be applied in various applications: S-DBM, Wibro, WPAN, CMMB and the entire UWB. The operating bands are evaluated by HFSS11 with the criterion of return loss S11 less than -10dB. Simulated radiation patterns over the whole frequency bands are acceptable.

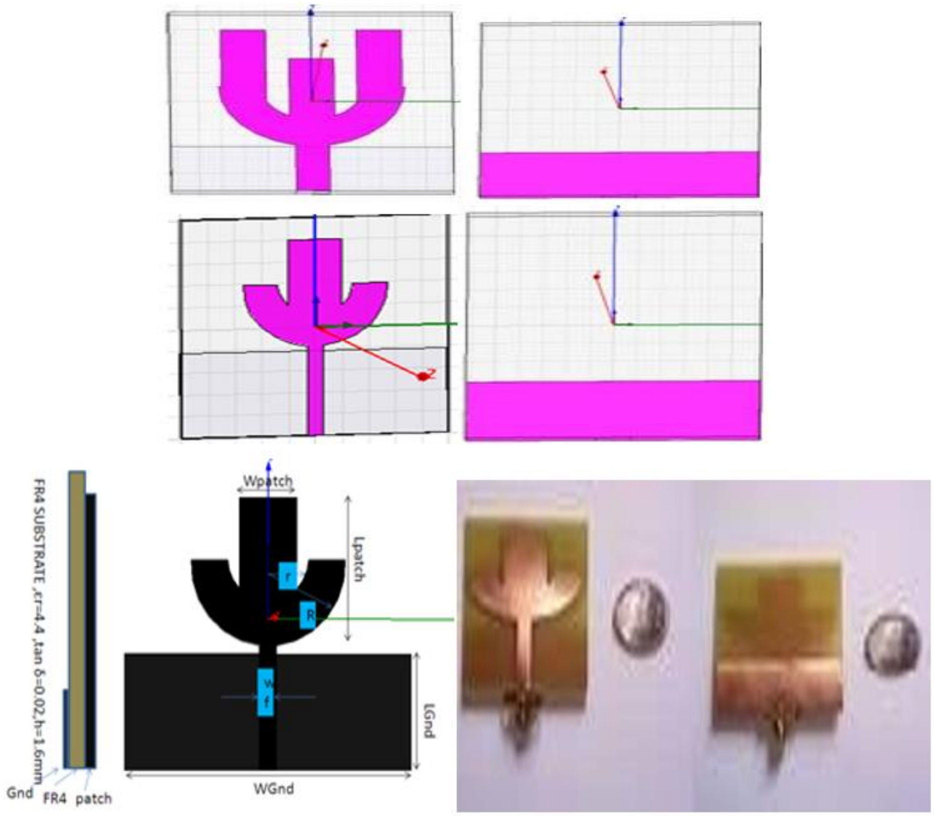

Figure 2: Geometry of basic trisul-shaped patch for UWB communication, (a). Top view, (b) bottom view, (c). Design geometry, (d). Photo graph of the proposed antenna.

Wsub = 25, Lsub = 25, Wp = 10, Lp = 12, Wg = 6.2, Wf = 3. (all dimensions are in mm)

Top view and front view of modified trisul -shaped patch antenna are indicated in figure 2. The proposed antenna is designed on a FR4 substrate with dielectric constant εr = 4.4 and height of the substrate is h =1.6 mm. The substrate has length L= 25mm and width W=25mm.The substrate is mounted on ground of 6.2 mm length and 25 mm width. The inner and outer dimensions are same

3. RESULTS AND DISCUSSIONS

The performance of UWB response depends on a number parameter, such as gap (g) between radiating patch and ground plane, width (wp) and length (Lp) of the patch and total width (wsub) and length (Lsub) of the substrate. The parameters which have significant effect on UWB response are analyze and studied. The gap between the radiating patch and the ground plane `g' affects impedance bandwidth because it acts as a matching network. The optimum UWB impedance bandwidth with dual band notched characteristic is obtained at g = 1.5 mm. The simulated VSWR of proposed antenna is shown in Figure9. The WiMAX band rejection can be tuned by changing the dimensions of Wsub, Lsub, Wpatch, Lpatch. The central band rejection frequency increases with decrease in Wp and rejection bandwidth decreases with decrease inLp. In Fig. 3, surface current distribution shown. Fig.4. 3D radiation pattern shown.

S11 of basic trisul patch antenna shown in Fig. 5. VSWR of basic trisul- shaped patch antenna shown in Fig. 6. Radiation pattern and S11 of the modified antenna shown in Fig.7. VSWR of modified trisul shaped patch shown in Fig. 8. Radiation pattern of modified trisul patch antenna at antenna (proposed) 3GHz, 5GHz, 7GHz shown in Fig. 9 These parameters can be tuned separately to get the notched band. The simulated S11, VSWR and radiation pattern of trisul and proposed antenna are shown in Figures

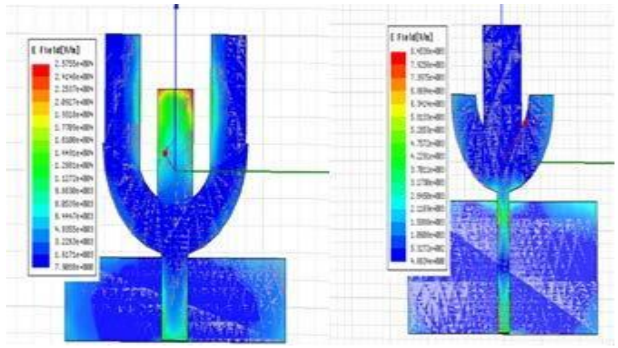

Figure 3: Current distribution of basic trisul-shaped patch and modified trisul -shaped patch antennas at 5 GHz

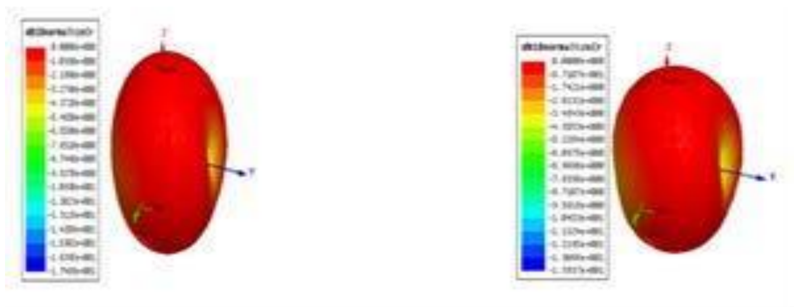

Figure 4: Simulated 3D pattern of trisul and modified trisul shape patch antennas at 5 GHz

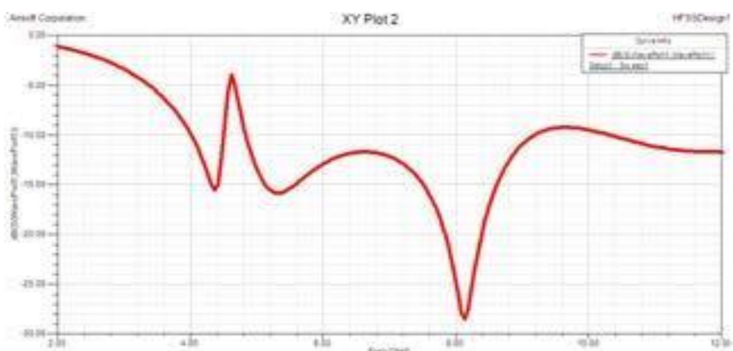

Figure 5: S11 of basic trisul patch antenna

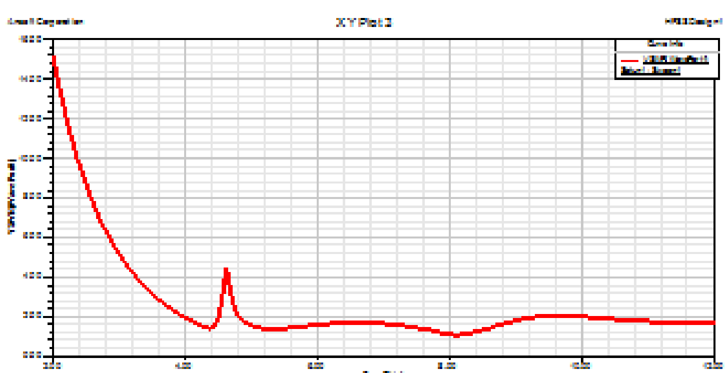

Figure 6: VSWR of basic trisul- shaped patch antenna

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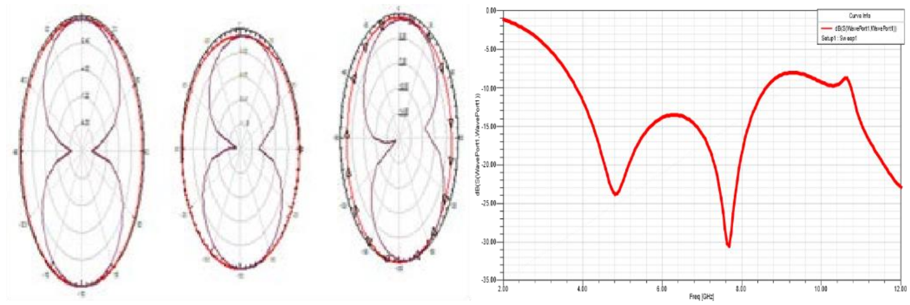

Fig 7: Radiation pattern of trisul- shaped patch antenna at **Fig 8: S11 of modified trisul shaped patch antenna (proposed)**

Figure 7: Radiation pattern and S11 of the modified antenna

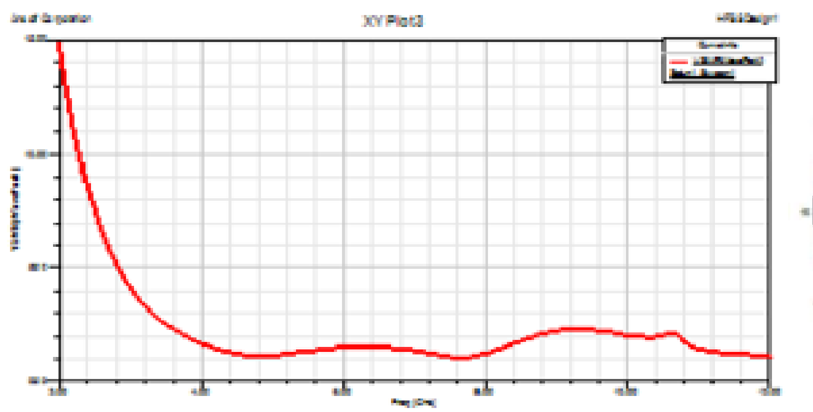

Figure 8: VSWR of modified trisul shaped patch

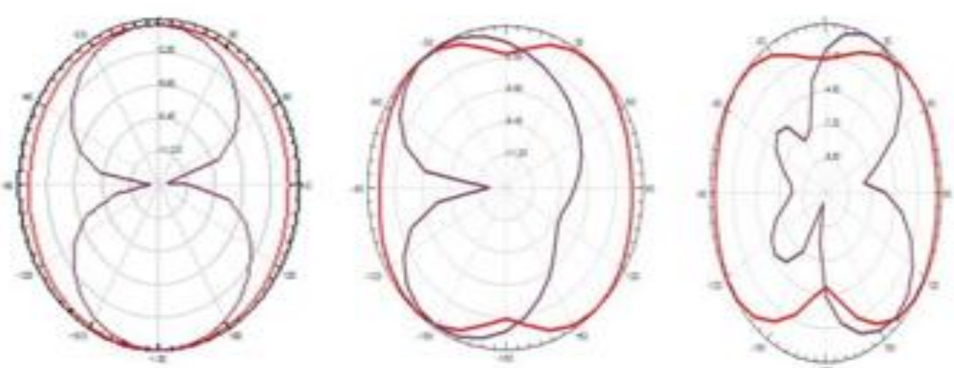

Figure 9: Radiation pattern of modified trisul patch antenna at antenna(proposed) 3GHz, 5GHz, 7GHz

4. CONCLUSION

A dual band miniaturized printed UWB antenna has been proposed for WPAN application. The modified trisul shaped patch antenna is simulated using HFSS11. The proposed antenna has the advantages of small size, easy fabrication and simple construction. The simulated results of radiation pattern at 3, 5, 7 GHz and S11 (return Loss) is also presented. The proposed antenna for return loss is less than -10 dB and VSWR is nearly 2 have shown that the antenna can be good candidate for ultra wide band application at the operating frequency of 7 GHz.

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