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# Ultra-Wideband Semi-Circular Patch Array Antenna Design for Unprecedented Bandwidthand Coverage in Wireless Communication

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**ABSTRACT:** Mobile devices must run a variety of real-time apps due to the rapid expansion of high-speed wireless mobile applications. Different applications call for different frequency bands to be used. This work presents a compact and wideband microstrip monopole array antenna that has been constructed. A prototype of the suggested antenna was erected on a FR-4 substrate and tested using high frequency simulation software (HFSS). The proposed antenna uses the 7.5GHz frequency range.The 35x35x1.4 mm2 suggested antenna has a moderate gain of 3.58 dBi. This monopoleantenna is small and has a straightforwardconstruction. In this frequency region, a returnloss of more than 10 dBi is seen. They are suitable for a variety of wireless applications.

**Index terms:** microstrip antenna ,broadband monopole antenna ,compact monopole,wimax application

## I. INTRODUCTION

With the rapid advancement of radio technology, a wide range of wireless applications have been quickly covered by communication system software development. Applications like WIFI, LTE, and WIMAX devices are all interested in the small size of the monopole. Due to the fact that certain antenna structures due to its lightweight design, small size, inexpensive price, and ease of installation with wireless microwave devices. It is well knowledge that shrinking an antenna will reduce its ability to radiate. Investigating methods for creating small microstrip antennas with promising radiation properties is crucial. For many wireless applications, including GPS, WLAN, LTE, WiMax, and UWB, the compact monopole antenna is regarded as the most significant antenna structure. This antenna has the benefit of a 16 by 60 cm substrate that is both small and wideband.When building an effective monopole antenna, a number of factors, including the antenna's size, effective bandwidth, gain, efficiency, and intended radiation pattern, should be taken into account. Therefore, it is important to analyze these variables in order to create an appropriate antenna design.

## II. PROPOSED MICROSTRIPARRAY ANTENNA

A narrow bandwidth is an intrinsic property of microstrip antennas. Real applications, on the other hand, generally call for bandwidth expansion. Smaller antenna diameters are required by contemporary wireless communication systems in order to meet the shrinking requirements for mobile units. Therefore, size reduction and bandwidth expansion are increasingly crucial design considerations for microstrip antennas used in practical applications. As a result, there is now a lot more study being done on how to make microstrip antennas work widely and compactly. Antennas need to be small and give circular polarisation, just like in satellite communication. These tiny, broadband, dual- frequency Microstrip antennas are intended for use in a variety of wireless communication applications, including personal mobile communication systems, DTH systems, WiFi systems, etc.

Given the aforementioned information, research into creating small, dual-frequency broadband antennas has significantly increased. Making slots in the ground plane or in theradiating patch, incorporating a shorting pin into a microstrip patch, and using high permittivity substrates are just a few of the efforts being made in this direction. Investigations into microstrip antenna designs are proposed to provide small, dual-frequency broadband antennas.

Modern communication systems are replacing old, cumbersome antennas with microstrip ones, although their applications are occasionally limited by their low strength and limited bandwidth. Smaller antenna diameters are required by contemporary wireless communication systems in order to meet the shrinking requirements for mobile units. As a result, decreasing size and boosting bandwidth are crucial design elements for microstrip antennas. Investigations into microstrip antennashapes are intended to provide small, dual-

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frequency, broadband antennas that can be applied to a variety of wireless communicationapplications.

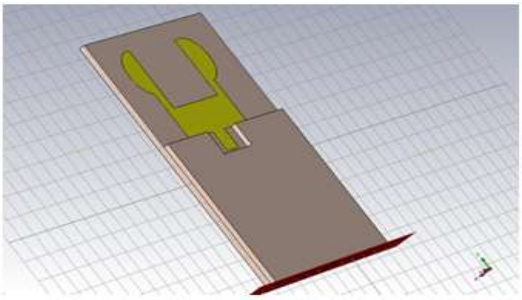
Antennas are a vital core part of any communication system since they transceive electromagnetic radiation signals, but occasionally their inability to adapt to new operating conditions could hinder system performance. In the past, antenna performance and design were tailored to a particular frequency, with the right polarisation and emission pattern. Multiband antennas, which are designed to address numerous bands or services at once, are currently the most practical and economical single wireless module option, despite the fact that dedicated single-band antennas may perform better. However, multiband antennas face substantial challengesas more wireless services are squeezed into ever-smaller devices. In wireless and mobile applications, electricity is divided and combined using power divider and combiner devices. Power dividers can be used as a feeding network for antenna arrays and power amplifiers as well as mixers, phase shifters, radar, measuring systems, etc. It is used in the field of radio technology to combine a specified amount of electromagnetic power in a transmission line from one port to another port.

## III. DESIGN STRUCTURE

With the aid of a circular patch structure in array form, the UWB antenna structure is created. The substrate for the suggested antenna is made of Rogers RO4003C material, has a height of 1.4 mm, and a loss tangent value of approximately 0.019. The dielectric lossy material of FR4 is built on the copper patch material, and the ground material is approximately 35x10x1.2mm3.

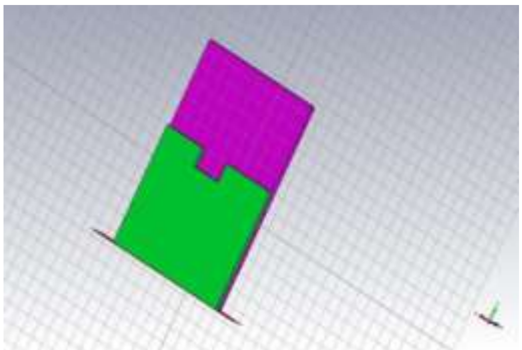
An array arrangement with wideband UWB is used for operating frequency spectrum to improve radiation characteristics. Designs for UWB and wideband antenna array filters frequently experience interference. While others have used BPFs (or other filters) in combination with antenna arrays to produce filtering antenna arrays with maximum and minimum fractional operating bandwidths of 88.76%, respectively.

A ground plane with a rectangular slot in the square plane is incorporated into the design. A circular antenna is created from the as indicated in Figure 1 during the design of the proposed antenna. The second phase involves optimizing antenna size by changing the ground plane and patch shapes as shown in Figure 2. However, these modifications are insufficient to utilize the full UWB bandwidth. However, there hasn't been much of an increase in bandwidth. In a subsequent stage, the suggested antenna's final construction is created using slots on the patch, ground plane, and substrate. Better UWB characteristics are greatly aided by the ground plane elliptical slot.



**Geometry design of the integrated UWB antenna array bandpass filter of ground plane**

With an impedance bandwidth of 1 GHz to 15 GHz, the reference antenna array in UWB onlycovers a limited portion of the UWB spectrum. This is due to the near closeness of the antenna array's components, which resulted in a strong mutual coupling, a narrow bandwidth of impedance, and a high reflection coefficient. According to reports, a UWB antenna array with a BP filter operates between 1 GHz and 15GHz with a comparable fractional bandwidth of 108.83%. The integrated architecture can suppress the highest frequencies up to 15 GHz.The reflection coefficient of UWB antennas without a bandpass filter, on the other hand, ranges from 1 GHz to 15 GHz, with a higher order created at roughly 14.5 GHz. This demonstrates that the upper and lower bands' possibilities for suppression have not been fully realised and may potentially interfere with some other wireless communication systems.



**Design of UWB antenna array with substrate.**

Since the previous twenty years, the field of wireless technology has experienced tremendous growth. The development of cellular technology

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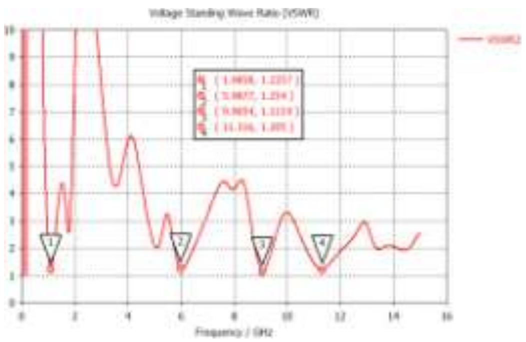
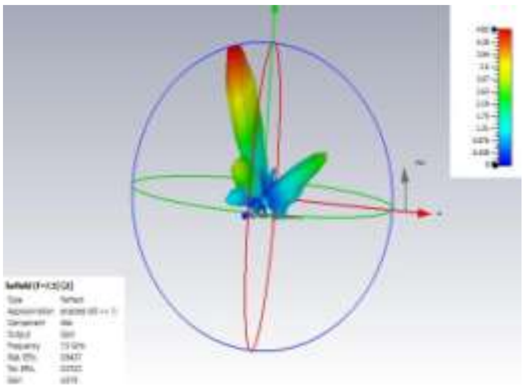
and the rise of several services that demand a lot of bandwidth are the key causes. The advancement of voice, data, and video telephony across wireless networks led to advancements that increased bandwidth. Along with these goals, designers are focusing on low power, little interference, and low radiation alternatives for current and future wireless applications. For a number of benefits, including higher data rates, lower power consumption, lower costs, extremely low interference, accurate positioning, and multipath immunity, as well as for higher image resolution in microwave imaging systems and better target characterization in UWB through wall imaging radar, ultrawideband (UWB) technology has been focused oncommunication systems.

## IV. SIMULATION RESULT AND EXPERIMENTAL VERIFICATION

The design, simulation, and experimental verification of a circular patch array antenna are presented in this section.



VSWR



GAIN

## V.CONCULSION

In this study, we analyzed the newest UWB antenna sensor capabilities and UWB applications in the realm of wireless applications. The growth of UWB has given WBAN solutions new possibilities, and many WBAN implementations offer an effective solution at an affordable price. While most UWB antennas may be used for frequency- domain communications (IR-UWB), only a tiny portion of them can be used for time- domain impulse or radar.The operational frequency has a substrate size of 35 x 35 x 1.4 mm2 and spans the UWB bandwidth of 1 GHzto 15 GHz. Additionally, the design displays a gain of 3.58 dBi. The simulative evaluation analyses the UWB characteristics of the antenna arrays that are better arranged for future outcomes. In order to obtain the higher gain in the simulation analysis, the patching approaches reduced the resonance frequency of a single element by around more percentage while preserving its original radiation pattern.

## REFERENCES

[1] C.A. Balanis, Antenna Theory: Analysis and Design, 3rd ed.Newyork,Ny,USA:Wiley,2005.
[2] Z.N Chen and Y. W. M Chia, Broadband planar Antennas: Design and Applications. Hoboken, NJ, USA:Wiley,2006.
[3] G.A. Deschamps. "Microstrip Microwave Antennas"in proc. 3rd USAF Symp. Antennas, 1953
[4] M. W.K. Lee, K. W. Leung, and Y.L. Chow, "Dual Polarization slotted miniature wideband patch antenna ", IEEE Trans. Antennas Propaga., vol.63,no. 1, pp.353-357,Jan. 2015
[5] Y.J. Cheng, Y.X. Guo, and Z.G. Liu, "W-band large scale high gain planar integrated antenna array," IEEE Trans. Antennas propaga., vol. 62,no. 6, pp.3370-3373, Jan 2014.
[6] A. A. Oliner and D. R. Jackson, "Leaky-wave antennas," in Antenna Engineering Handbook, J. l. Volakis, Ed. New York, NY, USA:McGraw-Hill, 2007
[7] S.W. Chen, D. Y. Wang, and W.H. Tu, "Dual-band/tri-band/broadband/CPW-fed stepped- impedance slot dipole antennas," IEEE Trans. Antennas propag., vol.62. no.1,pp485-490.Jan. 2014.
[8] J. W. Sze and K. L. Wong " Slotted rectangular microstrip antenna for bandwidth enhancement," IEEE Trans. Antennas Propag., vol. 48 no. 8 pp. 1149-1152 Aug . 2000.
[9] Ansys High Frequency Structure Simulator (HFSS)