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Design and implementation of U-Slot microstrip patch antenna using co-axial feeding technique for WLAN applications

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***Abstract*---**U-slot patch antenna design and implementation are discussed in this paper for 5.5GHz WLAN use. The VSWR and S11 of this suggested construction, which is based on FDTD techniques to attain the desired specification, are computed using the Computer Simulation Technology (CST) microwave studio. The maximum bandwidth while utilizing coaxial feed is 260 MHz, which corresponds to the WLAN frequency range of 5.36-5.62 GHz, and at its center resonant frequency, the gain is 5.3 dB. This antenna is designed to be used in conjunction with the coaxial feed antenna. In order to obtain a stable VSWR and low return loss, a frequency band adjacent to the present system must be used.

***Keywords*---**U-Slot, co-axial, wide band, S11, VSWR, WLAN.

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Introduction

For Wi-Fi systems, large bandwidth and high efficiency antennas are required to defend a wide frequency range, and a range of inventive WIFI applications, such as Wireless LAN, are in high demand. Because of its application in current wireless networks, the development of a small, wide-band antenna is a significant experiment. Size, low cost, low shape and conformability are the major constraints in high-implementation aircraft, mobile radio, missile, satellite, and wireless system applications. It's also becoming increasingly common for antennas to be multi-banded as technology progresses, which means they must be able to resonate at several frequencies. All of these requirements can be met by a PCB antenna. Along besides that, the low fabrication cost, maintenance-free operation, linear and circular polarization, and other benefits of a patch antenna are readily apparent. There are further challenges with microstrip patch antennas, such as surface wave excitation and thin bandwidth. The substrate height can be increased, the r of the substrate can be decreased, or a combination of these can be used to increase the bandwidth of a PCB. It is possible to use a second hand antenna array to increase bandwidth [2].

An antenna with a coaxial feed is first estimated here [3-4]. In this feeding strategy, the inside wire of the coaxial connector is attached to the radiating patch via soldering, and the outside surface of the conductor covers the ground all the way down to the substrate. The key benefit of this feeding setup is that the feed can be positioned anywhere inside the patch as long as the input impedance is suitably matched. An easy-to-manufacture feed technique with a low level of spurious radiation is available. There have been a slew of microstrip patch antennas with coaxial feeds available recently [5-8]. Co-axial feeding is shown in Fig.1. Additionally, the specifics of the supplied design performance can be accessed and explained.

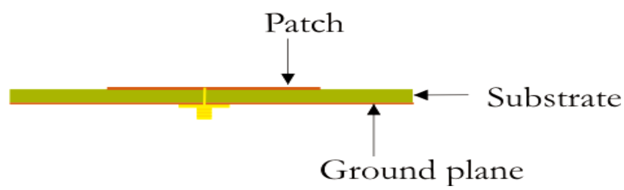

Fig 1. Technique of co-axial feeding

The design of antennas

Fig 2 and 3 demonstrate a rectangular patch coaxially fed an fr4 substrate on which was printed with a diameter of 1.6 mm and a permittivity (**ε**) of 4.3 dB. The patch, which is affixed to a 22.20 x 26.38 mm substrate, has a U-slot carved out of it. On the other hand, there's a substrate on the other side of the substrate, which serves as the antenna's ground plane, metal is deposited. Table I lists the antenna sizes that provide a wide bandwidth, which were discovered by iterative advancement.

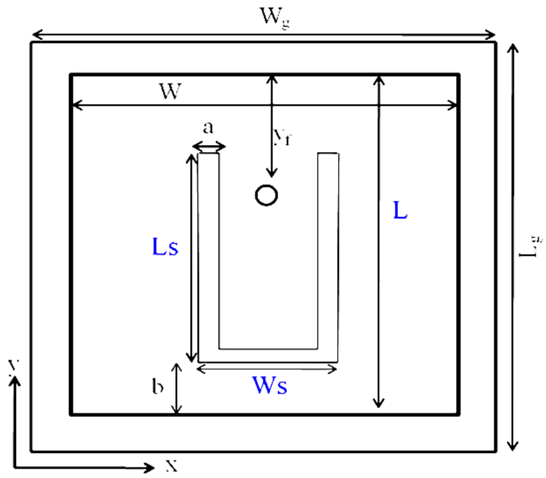

Fig.2 (a). The proposed U-slot microstrip antennas from the top

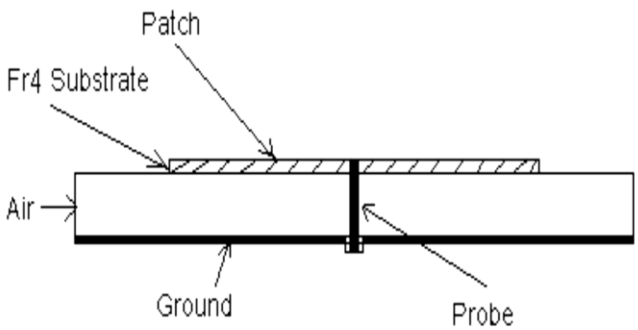

Fig 2 (b). A view from the side of the proposed U-slot microstrip antenna

To have the optimum 50ohm impedance match, the antenna's feed point should be (0, 6.30). The feed point was traced using a parametric sweep in the occupied region of the y-axis in the transient solver's space. Choosing the right impedance matching is always the best choice.

Table 1
Proposed u-slot microstrip antenna dimensions

Parameter	L_p	W_p	L_{Su}	W_{Su}	a	b	Y_f
Units (mm)	12.62	16.80	10.10	8.60	1.45	1.45	6.32

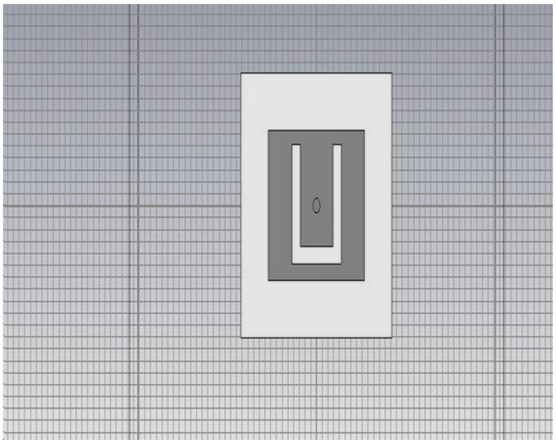

Fig 3. Proposed Design Structures

The results of testing and implementation

CST Microwave Studio is used to support the model readings of the antenna given here. It is shown in Fig.4 that the antenna's simulated reflection coefficient [S_{11}] in db has been calculated. Input signals are sent to the microstrip antenna via port 1, and this port's reflection coefficient is given by S11. For the normal procedure, it must be less than -10 dB. Microstrip antennas provide a characteristically broad response because to its resonance frequency of 5.5 GHz. When the reflection coefficient is set to -10 decibels, a simulated impedance bandwidth of around 536-562 GHz can be obtained. At this resonant frequency, the reflection coefficient value is extended to -16.16 dB. This is a significant value. Under the -10 dB frequency region, this figure of the S_{11} suggests that there is good corresponding. This. WLAN applications in the 5.36 to 5.62 GHz frequency range are particularly disabled.

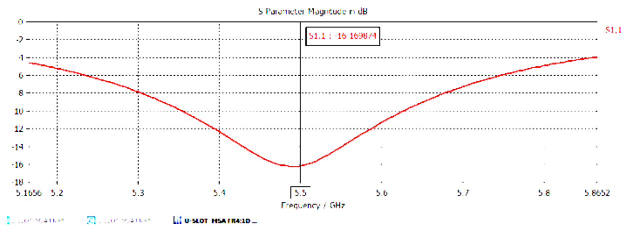

Fig 4. Simulation of the U-slot microstrip antenna's reflection coefficient [S_{11}]

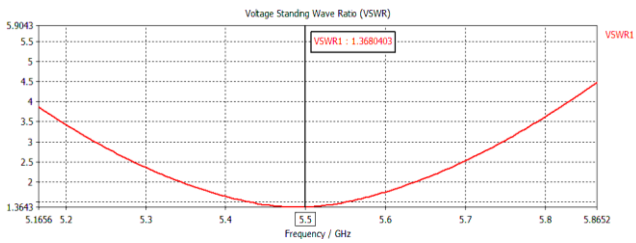

Fig 5. U-slot microstrip antenna VSWR simulation

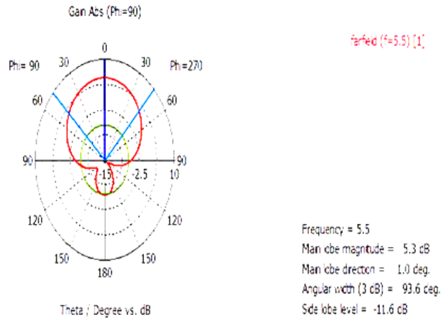

Fig 6. The U-slot Microstrip Antenna's simulated gain

Fig 5 shows the computed PCB antenna. Between 1 and 2 on the VSWR plot (Voltage Standing Wave Ratio) should be regarded important. SWR is a useful metric for determining the efficiency of transmission lines, such as the electrical cables that carry radio frequency signals, as well as for allocating cable television signals. U-slot microstrip antenna with VSWR of 1.36 has been made available for use in WLAN applications at 5.56 GHz. The concentration greatest gain is 5.3 dB at a 5.5GHz resonant frequency, as shown in Fig.6. At 5.5 GHz, the resonance frequency, this design was evaluated with a gain of 5.3 dB. Gain is too low to be useful in a practical procedure. By injuring other slots on the microstrip, we may further examine its structure.

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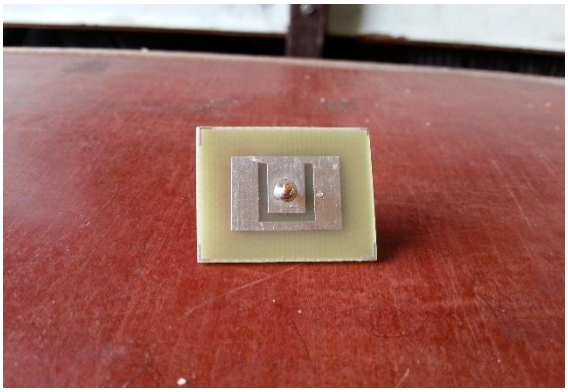
Fig 7.Fabrication of U-Slot Patch Antenna

Fig 8. Tested on Network Analyzer

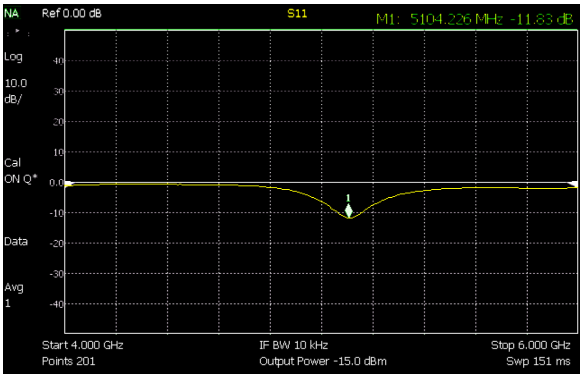

Fig 9.Tested Result Return Loss

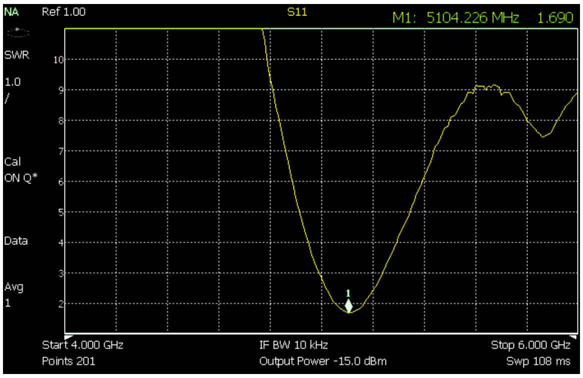

Fig 10.Implementation Results VSWR

Discussion

CST Microwave studio software was used to design a basic coaxial-feeding technique U-slot microstrip antenna for WLAN use at 5.5 GHz. This antenna may function at 5.5 GHz when used with IEEE 802.11 (5.18-5.8 GHz) wireless LAN applications. Because of proper impedance matching at the best feed location, it can be seen that the bandwidth of 260MHz at the 5.5 GHz resonant frequency may be achieved. At the resonant frequency, the reflection coefficient and VSWR are -16.16 dB and 1.36, respectively. The frequency range of 5.18 to 5.8 GHz is therefore covered.

Conclusion

A basic coaxial-feed U-slot microstrip antenna for WLAN use at 5.5 GHz was designed using CST Microwave studio software. The bandwidth of the antenna is around 260MHz (5.36-5.2GHz) and a -10 db Reflection Coefficient [S_{11}], which matches the 5.5 GHz indoor Wi-Fi standard. The greatest gain is 5.3 percent, and the maximum gain feasible is 5.3 decibels, assuming a reflectance coefficient of -16.16 decibels. The supplied antenna's coaxial feeding assembly can be adjusted to get the desired impedance match. Because it has a steady return loss, the future antennas can be utilized in wireless communication implementations; however, it can be expanded to different frequency applications by adding many slot patterns on the ground or on the patch, making it a defective ground.

References

1. Chopra, P., Gollamandala, V. S., Ahmed, A. N., Babu, S. B. G., Kaur, C., Achyutha Prasad, N., & Nuagah, S. J. (2022). Automated Registration of Multiangle SAR Images Using Artificial Intelligence. *Mobile Information Systems*, *2022*.
2. M. Mahmoud, "Improving the Bandwidth of U-slot Microstrip Antenna Using a New Technique (Trough-Slot Patch)" Region 5 IEEE Conference.
3. A. B. Smolders, "Broadband microstrip array antennas" Antennas and Propagation Society International Symposium, 1994.
4. Kaur, C., Boush, M. S. A., Hassen, S. M., Hakami, W. A., Abdalraheem, M. H. O., Galam, N. M., Hadi, N. A., Hadi, N. A., & Benjeed, A. O. S. (2022). Incorporating sentimental analysis into development of a hybrid classification model: A comprehensive study. International Journal of Health Sciences, 6(S1), 1709-1720. https://doi.org/10.53730/ijhs.v6nS1.4924
5. Jun-Hai Cui, Shun-Shi Zhong, "Compact microstrip patch antenna with C-shaped slot" Microwave Conference, Asia-Pacific, 2000.
6. Anjum, Afsana & Kaur, Chamandeep & Kondapalli, Sunanda & Hussain, Mohammed & Begum, Ahmed & Hassen, Samar & Boush, Dr & Benjeed, Atheer & Abdulraheem, Dr. (2021). A Mysterious and Darkside of The Darknet: A Qualitative Study. Webology. 18. 285-294.
7. K. Kumar and N. Gunasekaran, "A Novel Wide Band Planar n Shaped Base Station Antenna", International Conference on Communications and Signal Processing (ICCSP), 2011.
8. Kaur, Chamandeep. (2020). The Cloud Computing and Internet of Things (IoT). 7. 19-22. 10.32628/IJSRSET196657.

9. J. Kaur, R. Khanna and M. Kartikeyan, “Design of co-axial fed broadband single layer rectangular microstrp patch antenna for wireless applications” J. Engg. Technol., Vol. 3, No. 2, pp. 71-75, 2013.
10. Aarif, Mohd & Alalmai, Ali. (2019). Importance of Effective Business Communication for promoting and developing Hospitality Industry in Saudi Arabia. A case study of Gizan (Jazan).
11. R. Garg, P. Bhartia, I. Bahl and A.I tipiboon, “Microstrip antenna design handbook”, Artech House, Boston – London, 2000.
12. Kaur, Chamandeep. (2019). The Study of Resource Management in Big Data Using Cloud Computing. 7. 91-94.
13. C. A. Balanis, “Antenna Theory Analysis and Design”, Third Edition, Wiley, New Jersey, 2005.
14. Kaur, Chamandeep & Mourad, Hanan & Banu, Sayyada. (2019). Security and Challenges using Clouds Computing in Healthcare Management System.
15. Alalmai, Ali & A., Arun & Aarif, Mohd. (2022). Social Media Advertising Impact on the Consumer Purchasing.
16. N. A. Murad, M. Esa and S. Tukachil, “Microstrip U-Shaped Dual-Band Antenna” Asia-Pacific conference on Applied Electromagnetics Proceedings, 2005.
17. Tripathi, M. A., Tripathi, R., Sharma, N., Singhal, S., Jindal, M., & Aarif, M. (2022). A brief study on entrepreneurship and its classification. International Journal of Health Sciences, 6(S2). https://doi.org/10.53730/ijhs.v6nS2.6907
18. Kaur, Chamandeep & Sharma, Dr. Yogesh. (2020). The vital role of VPN in making secure connection over internet world. 8. 2336-2339. 10.35940/ijrte.F8335.038620.
19. Alalmai, Ali & Fatma, Dr Gulnaz & A., Arun & Aarif, Mohd. (2022). Significance and Challenges of Online Education during and After Covid-19. Türk Fizyoterapi ve Rehabilitasyon Dergisi/Turkish Journal of Physiotherapy and Rehabilitation. 32. 6509-6520.