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Design of Micro-Miniaturized Printed Monopole Antenna for WLAN/WIMAX Operations in Laptop Computers

Zubair Nazir Sheikh, Shaveta Bala
Department of Electronics and Communication Engineering,
Universal Institute of Engineering and Technology,
Lalru, Punjab, India
zubair.nazir786@yahoo.in, shavetabala@ugichd.edu.in

Abstract- With an air-filled hole thickness between the receiving wire and the system ground, a one-of-a-kind labyrinth molded printed double band monopole miniature scaled-down receiving wire of 6 x4x1.6 mm^3 is proposed. The essential elements of the labyrinth molded transmitting structure are to protract the surface current course on the emanating surface and to work on the transmission capacity across the two groups of interest, which are the Bluetooth fl (2.40-2.48)GHz band and theWireless Local Area Network (WLAN) guidelines' fu (5.15-5.85GHz high recurrence groups). The proposed receiving wire includes a more straightforward comparable circuit model, and its reproduction is done. The proposed receiving wire likewise has a respectable increase of (2.72-6.62) dBi and an ideal radiation effectiveness of (61 to 91)% over the functioning groups notwithstanding the previously mentioned qualities. The proposed receiving wire structure is viewed as appropriate for WLAN/WiMAX applications in the personal computer (PC) on the receiving wire's reenactment and estimation discoveries, which are viewed as in great arrangement.

Keywords- Antenna Design, MIMO, Wireless Network, Bluetooth

I. INTRODUCTION

One of the most mind-blowing techniques for making a little multi-band receiving wire is collapsing the transmitting patch since it is easy to comprehend and requires no extra space or cash [1]. The collapse of a radiation band more effectively changes the direction of the surface current across a transmission array and essentially extends the transmission path continuously over a frequency band of length moderate by transmission. This surface current conduction on the emitting pad causes a severe reduction in the size of the radio wire at full repeatability [1, 2]. Due to the lower Q calculation of the transmission band is narrowed, so the transmission capacity of the receiving line will be extended.

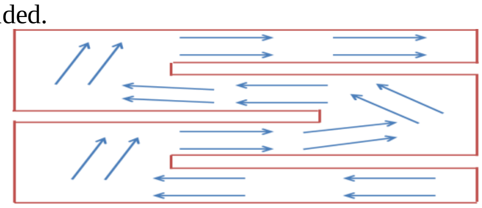

Fig. 1. Schematic diagram of surface current distribution on fold in gradiating patch.

By appropriately changing the components of collapsing, the proposed receiving wire can furnish adaptable tuning of wanted groups with the required transfer speed. The all-out length LX1 and LY1 of collapsed monopole emanating pieces of 'X' and 'Y' separately are roughly equivalent to one-quarter frequency long at reverberating recurrence of 2.45GHz and 5.5GHz individually [3]. They are as follows:

$$L_{X1}=L_1+2L_2+2L_3+W_2+W_3+W_4+W_5+W_6+W_7+L_{Y1}$$

$$L_{Y1}=L_4+W_9+2L_5+W_{10}$$

II.LITERATURE SURVEY

A small radio wire ground and a gathering plate are short-circuited to the rectangular transmitting plate. The get-together plate fills in as both a radio wire ground and an establishment support plate for receiving wires. The coaxial-line feed line takes care of the monopole [1-4]. The receiving wire capabilities as anInverted F Antennas (INF) receiving wire for the low recurrence (2.4 GHz band). The INF emanating strip is where most of the ongoing ventures [5]. Because of the unobtrusive current in the L-formed strip and tab areas, the low-recurrence district is unaffected.The size of the radio wire is often enormous in the lower band since the receiving wire is a half-frequency dipole. Be that as it may, the lower band execution of the radio wire is great, and it has a huge data transfer capacity [6-8].

In [9-11] view of printed half-frequency dipole receiving wires for certain drifting and unequivocally associated components for double band applications. With a polyamide film having a dielectric consistent of 3.0 stuck onto the ground plane and 0.1mm thick planar receiving wire structure, the receiving wire is given solidness and insurance from other metal gadgets [12].The driven band mainly contributes to the excitation of the WLAN band above 5 GHz, while the parasitic band contributes to the excitation of the WLAN band below 2.4 GHz. The space required to install the antenna inside the laptop is 3x5x20 mm^3[13-15].It comprises of a more extended emanating strip, a more limited transmitting strip, a shorting strip, and a parasitic transmitting strip. While the more limited strip and the parasitic strip cooperate to make a wide 5GHz functional band, the long strip controls the lower 2.4GHz recurrence [15-18].

To cover 2.4GHz and 5.2/5.8GHz WLAN activity, two wide groups can be framed for the receiving wire utilizing the more limited strip and the more drawn-out strip with the chip-inductor consolidated in it [19]. For making proper recurrence groups, utilizing an extra responsive part might bring about expanded power utilization and gadget intricacy.The 5GHz range is covered by a circle that is a portion of a frequency long. Observe that the ground plane supplies half of the circle. Both the 2.4 GHz and (5.15-5.825) GHz groups are upheld by the plan[20].

III.PROPOSED METHODOLOGY

The proposed receiver wire is printed on a single FR-4 substrate 1.6 mm thick with relative dielectric stability ′ ∈′ **of4**. **3** and the unfortunate digression **tan**✿**of** 0.025. The base size is only 6x4mm^2. The basic structure of the radio

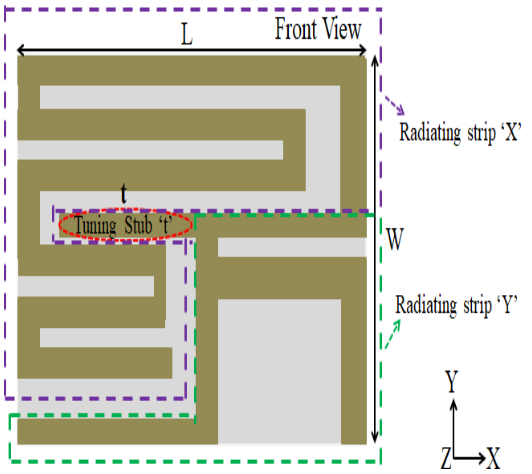

Fig. 2.Front view of the proposed antenna without system ground.

wire consists of a labyrinth-shaped radiating joint and a 't'-length tuning protrusion. The complex patterned radiation fixation process involves two collapsed unipolar transmission bands, namely 'X' and 'Y' to support distinct **fl** and **fu** groups. Fig. 2 and Fig. 3 illustrate the proposed mounting of the received wire on the mass of a system of size **260** × **200mm**^{2} with an air-filled opening thickness "g" and showing the level "h" above the volume of the system. The mass of the system is 0.2 mm thick and 91% is metal. The proposed receiver wire includes a 50ω reduced coaxial feed link, with the focus emitter and setup enclosure linked to point "A" on the proposed radio line and point "B" on the ground. individual system. A detailed study of the proposed wireless research plan will be presented from the two perspectives that go with it .

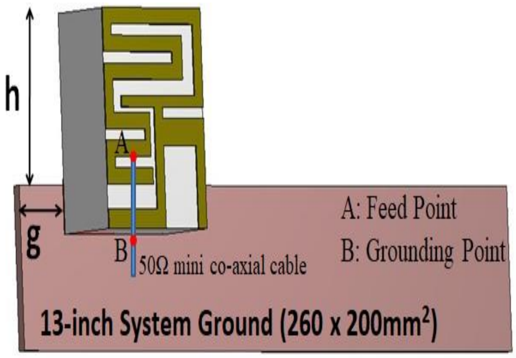

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Fig. 3.Perspective view when the antenna is mounted on system ground

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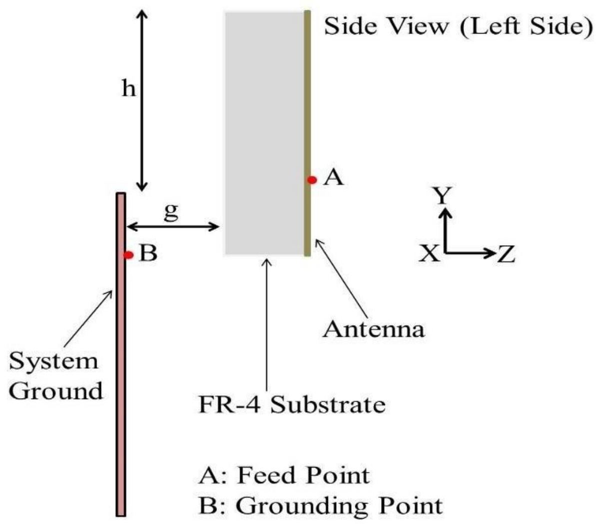


Fig. 4.The left side of the recommended antenna.

III.WORKING MECHANISM

To obviously represent how the miniature scaled-down, printed double band labyrinth formed monopole radio wire was planned, Fig. 4 shows the bit-by-bit advancement cycle of the proposed receiving wire configuration utilized in CST Microwave studio and compares recreated reflection coefficient (dB) results at various stages.

Insects underground was shaped by printing the newly collapsed "X" monopolar emission band onto the FR-4 substrate. Ant.1 is mounted on the system floor with a 'g' thickness air-filled hole and energized at points 'A' and 'B' by a 50ω reduced coaxial feed line. This air-filled hole thickness 'g' among Ant.1 and system ground goes about as an air hole capacitance. This hole capacitance and excitation of Ant.1 reverberate at 2.45 GHz effectively. Further, to energize the reverberation around 5.5 GHz, the collapsing monopole transmitting strip 'Y' was presented from point 'D' without upsetting the Ant.1, the total construction shapes the Ant.2. The Ant.2 and air hole resounds at a higher recurrence of 6GHz yet additionally moves the reverberation of 2.45GHz towards the higher recurrence of 3GHz and doesn't satisfy 2.4GHz WLAN guideline and Bluetooth band because of corruption in impedance bungling. Subsequently, to further develop the impedance coordinating and to get wanted fl and fu groups, an unassuming tuning stub of length 't' was jutted from point 'C' framing Ant.3 (being proposed radio wire). This 't' tunes fl as (2.39-2.51)GHz band and fu as (4.90-6.09)GHz band. Thus, the proposed radio wire works in double groups in particular fl and fu covering 2.4GHz and 5GHz working groups of WLAN and 5.8GHz of WiMAX band.

1. Simulation and Results

To study and increase the thickness of the air-filled hole 'g' between the receiving wire and the system ground, the parametric test reproduces with a 'g' offset from 0 to 1.6 mm during synchronization, 0.4 mm addition was performed in the necessary groups of fl and fu using CST Microwave studio. Fig. 5 shows the reflectance (dB) against repetition of different highs of 'g' for the proposed radio wire. When g = 0 mm, no group is excited because no clearance capacitance occurs. From Fig. 6, it can be seen that the 'g' of 1.6 mm gives the expected impedance data transfer at VSWR < 2 for fl and fugroups.

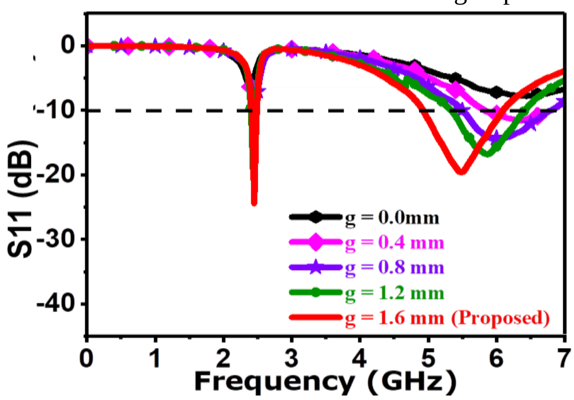
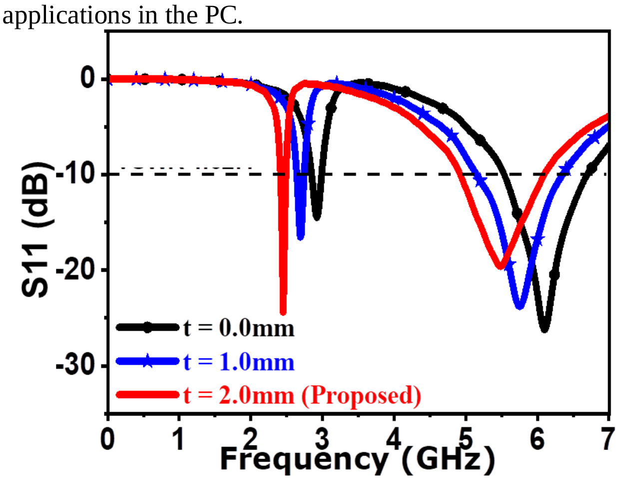


Fig. 5. Effects of protruded tuning stub of length(t).

To upgrade the projected tuning stub 't', 't' is fluctuated from 0 to 2.0mm in sync additions of 1mm. From the reproduced reflection coefficient bends, it is seen that when 't' increments from 0 to 2mm, fl and fu moves straightly from (2.85 to 2.39) GHz and from (5.5 to 4.90) GHz individually, because of the capacitive coupling between tuning stub and width W12 and subsequently accomplishes appropriate impedance coordinating. In view of the above results, 't' of the tuning stub is taken as 2mm as it covers WLAN and WiMAX groups for remote applications in the PC.



(1)

Fig. 6. Effects of effective height (h) of proposed antenna above the system ground.

To streamline the powerful level 'h' of the receiving wire over the system ground, the reenacted parametric review with 'h' differing from 2mm to 4mm in sync additions of 1mm is shown in Fig.7. It is seen that for 'h' of 2mm and 4mm, there is no impact on fl, yet the transmission capacity of fu gets impacted and doesn't cover the whole 5GHz high recurrence band. Consequently, it is to be noticed that a viable 'h' of 3mm of the radio wire over the system ground is chosen as both the ideal fl and fu groups are acquired.

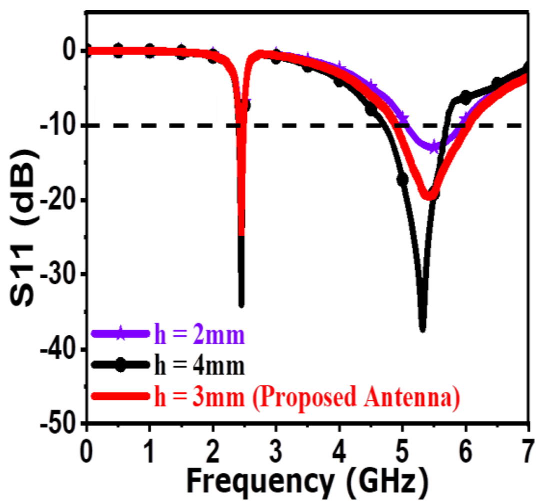


Fig. 7. Effects of various sizes of system ground plane.

To further evaluate the proposed radio wire inclination for different floor sizes of the system, Fig. 8 shows the reconstructed reflectance keeping all remaining limits unchanged. The floor measurements of the presentation monitor support system vary from 5" to 17". There is a tendency to assert that the proposed receiving wire behaves in the same way for all concentration sizes of the system mass without affecting the data transmission impedance and the magnitude of the reflectance. in the fl and fu groups.

Table 1 verbalizes the improved upsides of boundaries which are gotten from parametric concentrate across two groups of interest $f_l$andf_u.

Table1.Optimized dimensions of the proposed antenna essential parameters obtained from a parametric study.

Name of the Parameter	Notation	Value(mm)
Air-filled cavity thickness	g	1.6
Open overhang heel length adjustment	[illegible]	[illegible]
Effective height of top antenna system grounding	h	[illegible]

To additionally make sense of the working guideline of the proposed receiving wire structure, the bend of info impedance Zin versus recurrence. It is plainly seen that when the proposed receiving wire is working in fl and fu groups, the info impedance of the proposed receiving wire is steady around 50ω and reactance is practically equivalent to 0ω. This condition shows that the proposed radio wire has accomplished great impedance coordinating and double band working recurrence attributes, demonstrating that the proposed receiving wire structure is appropriate for WLAN guidelines and WiMAX applications in PCs.The other boundaries are streamlined by involving improvement procedures in CST MWS and are listed in Table 2.

Table2.Optimized size of the recommended antenna.

Parameter	Value(mm)	Parameter	Value(mm)	Parameter	Value(mm)
L1	2.7	W2	0.8	W8	0.35
L2	4.8	W3	0.9	W9	0.5
L3	6.0	W4	1.2	W10	2.4
L4	3.5	W5	0.8	W11	2.0
L5	3.0	W6	0.8	W12	0.2
W1	0.3	W7	1.8		

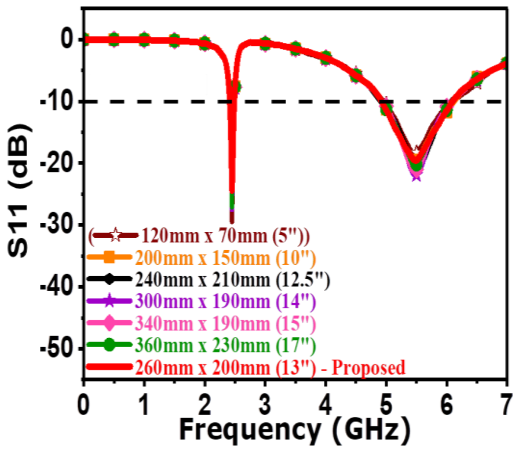


Fig. 8. Simulated reflectance as a function of proposed antenna mounting at different system mass sizes.

VI. CONCLUSION

For remote tasks in the PC, a small printed double band monopole radio wire with the aspects 6x4x1.6mm^3, a distending tuning stub of 2x0.2mm^2, and an air-filled hole thickness of 1.6mm have been proposed and demonstrated. It has been effectively investigated what various variables mean for the exhibition of the recommended radio wire for the fl and fu bands. For WLAN/WiMAX tasks in the PC, the fl and fu have exhibited 10dB estimated impedance transmission capacity of 6.5% (2.37-2.53) GHz and 16% (5.05-5.90)GHz, separately. The deliberate reflection coefficient of the recommended radio wire and the related circuit model, which was reenacted, were viewed as in great understanding. The proposed receiving wire's appropriateness for WLAN/WiMAX applications in the PC is presented by the reenacted and estimated RF execution.

REFERENCES

1. Balanis, CA 2005, Antenna theory analysis and design, 3rd Edition, John Wiley and Sons, Inc., Hoboken, New Jersey.
2. Brown, GH and Woodward, Experimentally determinedradiation characteristics of conical and triangular antennas, RCA Review, vol. 13, no. 4, pp. 425-452.
3. Chen, ZN 2000, Impedance characteristics of planar bow-tie-like monopole antennas, Electronics Letters, vol. 36, no. 13, pp. 1100-1101.
4. Chen, ZN, Amman, MZ, Chia, MYW and See, SP 2003, Circular annular planar monopoles with EM coupling, IEEE Proceedings: Microwave, Antennas and Propagation, vol. 150, no. 4, pp. 269-273.

5. Thakur A, Talluri SR, and Panigrahi RK 2019, Side-lobe reduction in pulse compression having better range resolution,Computers and Electrical Engineering Journal, vol. 74, pp. 520-532.
6. Chen, ZN, Chia, MYWoo,andAmman, MJ 2003, Optimization and comparison of broadband monopoles, IEEE Proceedings: Microwave, Antennas and Propagation, vol. 150, no. 6, pp. 429-435.
7. Chen, ZN, Hirasawa, K and Wu, K 2001, A novel top-sleeve monopole in twoparallelplates,IEEETransactionsonAntennasandPropagation, vol. 49, no. 3, pp. 438-443
8. Thakur A, and Saini, DS 2021, MIMO radar sequence design with constant envelope and low correlation side-lobe levels, International Journal of Electronics and Communications, vol. 136.
9. Cheng-Tse Lee and Kin-Lu Wong 2009, Uniplanar printed coupled-fed PIFA with a band-notching slit for WLAN/WiMAX operation in the laptop computer, IEEE Trans. Antennas Propag., vol. 57, no. 4, pp. 1252-1258
10. Chih-Ming Su, Wen-Shyang Chen, Yuan-Tung Cheng and Kin-Lu Wong 2004, ‘Shorted t-shaped monopole antenna for 2.4/5 GHz WLAN operation,Microwave,and Optical Technology Letters,vol.41,no.3,pp.202-203.
11. Thakur A, and Saini, DS 2022, Mitigating peak side-lobe levels in pulse compression radar using classical orthogonal polynomials,Wireless Networks, vol. 28, pp. 2889-2899.
12. Thakur A, and Saini, DS 2020, Bandwidth optimization and side-lobe levels reduction in PC radar using Legendre orthogonal polynomials, Digital Signal Processing, vol. 101, Jun 2020.
13. Chih-Yu Huang, Chia-Chou Tsai,and Cheng-Fu Yang 2010, Lowprotruding monopole antenna with a slot cut in the ground plane for laptop applications, Microwave and Optical Technology Letters, vol. 52, no. 11,pp.2610-2613.
14. Desmond CY, Chien HY, and Lee CH 2014, Uniplanar antenna design with the adhesive ground plane for laptop WLAN operation, IEEE Antennas Wirel. Propag. Lett., vol. 13, pp. 337-340.
15. Thakur A, and Saini, DS 2022, Modifying polyphase codes to mitigate range side-lobes in pulse compression radar,Wireless Personal Communications, vol. 123, pp. 693-707.
16. Hu CL, HuangDL, Kuo, HL, Chang-Fa Yang, Chang-Lun Liao and Lin ST 2010, A compact multiband inverted-Fantenna for LTE/WWAN/GPS/WiMAX/WLAN operations in the laptop computer, IEEE Antenna Wirel. Propag. Lett., vol. 9, pp. 1169-1173.
17. Devendra K Mishra 2001, Radio Frequency and Microwave Communication Circuits Analysis and Design, John Wiley and Sons, Inc.
18. Duixian L, Ephraim F, and Gaucher, B 2002,Integrated