DESIGN OF 5.2 GHz YAGI-UDA ANTENNA FOR WIRELESS COMMUNICATION APPLICATION

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Abstract — In this paper a high gain and broadband Yagi-Uda antenna is presented for wireless communication application at frequency of 5.2 GHz. The HFSS simulation software is used to simulate the design. FR-4 substrate material with dielectric constant of 4.4 and height of 1.6 mm is being used to design the antenna. It achieves high gain with wide bandwidth.

***Index Terms*— Yagi-Uda antenna, Reflector, Director, Driven dipole, FR-4, HFSS**

I. INTRODUCTION

The Yagi–Uda antenna, first published in an English language journal in 1928 [1], has been used extensively as an end-fire antenna. Yagi–Uda antennas have been widely used for VHF/UHF application and for many microwave and millimeter-wave applications due to their high gain, low cost, high radiation efficiency and ease of fabrication. An antenna consists of a driven element (fed by the source) and parasitic elements (a reflector element and one or more director elements). The physical characteristics of antenna are directed by the induced current in the parasitic elements due to the fields created by the dipole. In wireless application a Planar, thin, light weight antennas are preferred. The planar antenna is one of the most popular types of antennas for wireless LAN applications, because it is easily integrated with other passive and active microwave devices is given by Khade et.al, (2013) [1]. There are various types of WLAN standards like High Performance LAN (HIPERLAN), next generation wireless networking (NGMN) and high speed broadband system which uses frequency band of 5.2 GHz–5.725 GHz. In this frequency range high gain and low backside radiation are produced.

The most common antenna used for the communication system is Yagi-Uda antenna because it is simpler, easy to design, low cost and high gain. With the growth in communication system for many applications such as in radar, medical, industrial and wireless communication there is a need of an antenna which provides a directional beam in particular direction, which is obtained by Yagi-Uda antenna

II. ANTENNA DESIGN

The design of the proposed antenna is shown in Figure 1. As can be seen from the figure, the Yagi-Uda antenna was built on a FR4 substrate ($\varepsilon_r = 4.4$) with the thickness of 1.6 mm. The design consists of one director element, a driven element and a ground plane acting as a reflector. Truncated ground plane is used to maximize the antenna gain, if truncated ground plane is not used then a power given to the driver dipole element will not radiate and return to the ground plane itself. The bottom plane that will act as a truncated micro-strip ground plane, which serves as the reflector element for the antenna and the parasitic director elements is placed on the top plane simultaneously which directs the antenna propagation toward the end-fire direction, and acts as an impedance matching element. The driven dipole is built on both sides of the substrate and connector with characteristics impedance of 50 Ω is used for providing the excitation to driven dipole of antenna.

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It was noticed that the use of second director does not give the appreciable increment of gain, but leads to increase the size of antenna only. To enhance the gain of antenna coupling structures are placed between the reflector and the driven element. The Yagi-Uda antenna is one of the most popular endfire antennas but the microstrip structure usually radiates in all the direction that's why a metal plate is placed at a distance of 15 mm to reflect the power back to the dipole. So that maximum radiation takes place in endfire direction.

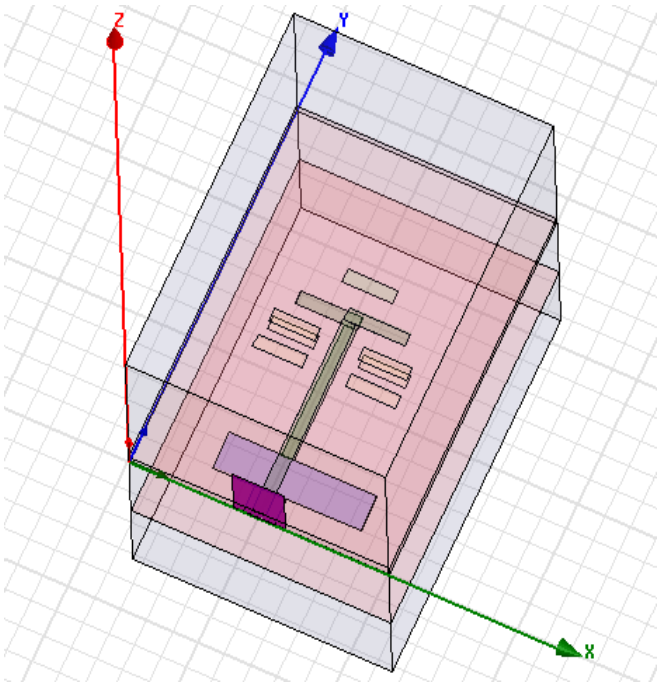

Figure 1: Geometry of proposed Yagi-Uda antenna

III. SIMULATIONS AND RESULTS

HFSS simulation software is used to simulate the proposed antenna design and parameters such as Bandwidth, Return loss are observed.

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Figure 2 shows gain of 7.05 dB (9.19 dBi) of the Yagi Uda antenna at 5.2 GHz. Antenna gain is the ability of an antenna to direct radiations in a particular direction.

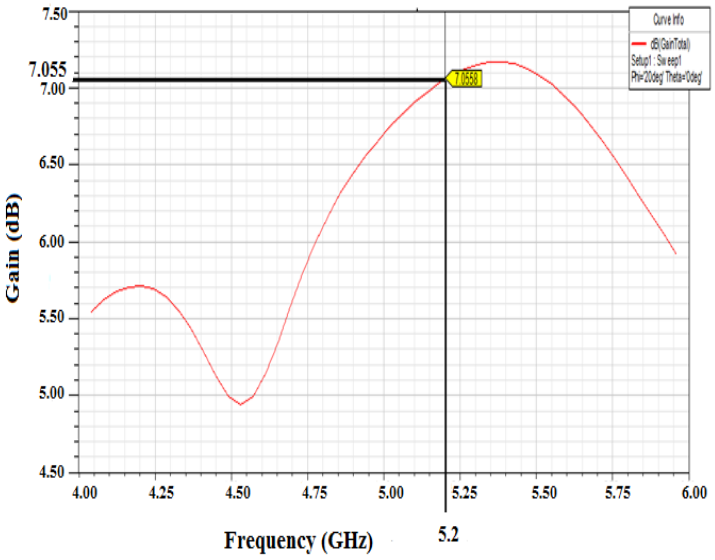

Figure 2: Simulated gain of proposed Yagi-Uda antenna.

Figure 3 shows the return loss and bandwidth of the Yagi Uda antenna that operates at a frequency of 5.2 GHZ. The simulated yagi uda antenna has wide bandwidth of 1.8 GHz with return loss of <-10 dB.

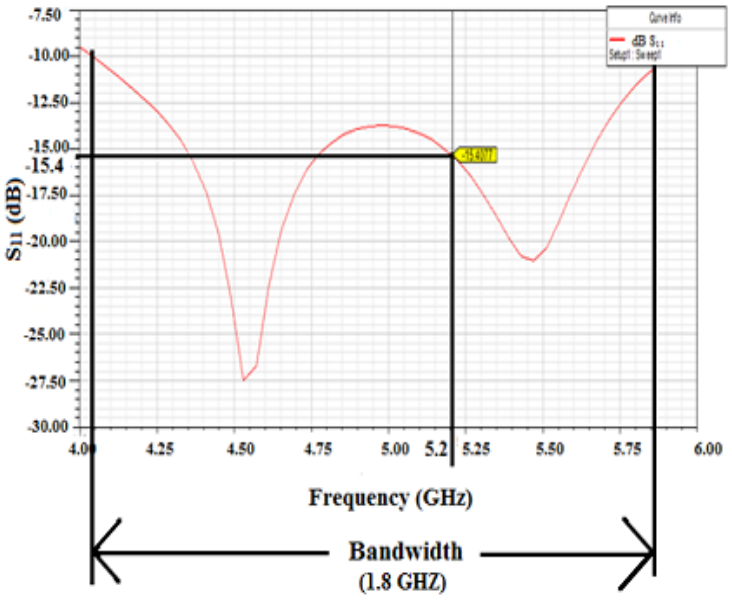

Figure 3: Simulated return loss and bandwidth of proposed Yagi-Uda antenna

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IV. CONCLUSION

A proposed Yagi-Uda antenna has been successfully designed at 5.2 GHz with one director, driven dipole and a reflector by using HFSS simulation software. The designed antenna achieves gain of 9.19 dBi, return loss of 15.4 dB with wide bandwidth (1.8 GHz). Thus, high gain and broad band antenna is suitable for WLAN, NGMN and other wireless communication applications.

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