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# Design Of Patch Antenna And 1x2 Patch Array For Wifi Applications

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**Abstract- The antenna is used to receive RF/Microwave signal and the rectifier is used to convert the received RF/Microwave signal into DC signal. In this work, the design and simulation of the rectangular microstrip patch antenna and arrays are carried out at 2.45GHz frequency for low-profile wireless applications. Initially a rectangular microstrip patch antenna is designed at 2.45GHz frequency using an electromagnetic solver. The antenna design parameters are optimized using the above electromagnetic solver. Rectangular microstrip array of 1×2 is designed using feed network at the same frequency. The inter-element spacing of the antenna is 0.75$\lambda_0$. The antenna radiation parameters such as return loss, gain, directivity, efficiency and 3D radiation patterns are obtained for single patch and array. The antenna radiation parameters are compared for the antenna and arrays. From the simulation results, it is observed that the gain and beamwidth of the antenna array are increased and decreased respectively for the increase in elements in the array.**

**Keywords – Microstrip antenna, Wireless communication ,Directivity, Efficiency, Gain**

## I. INTRODUCTION

Microstrip antenna was introduced from microstrip circuit technology and has inherited many characteristics such as low radiating efficiency and narrow bandwidth that are undesirable for a radiator. However, they offered many desirable features in terms of small size, low profile, ease of integration with circuits and forming arrays. Consequently, research has been focused to improve their performance as radiators. Modern mobile communication systems are increasingly employing phased array at base stations to expand the base station customer capacity and reduce interference among adjacent stations. In the wireless industry, such antennas are typically referred as smart or adaptive antenna. Reflector, horn and microstrip array antenna are widely used in microwave applications. In this work, the rectangular microstrip patch antenna array is designed and simulated at 2.45 GHz frequency. The design parameters of single antenna and 1×2 antenna array are optimized using an electromagnetic software. The antenna parameters such as return loss, gain, efficiency, directivity, and radiation pattern are obtained using the electromagnetic simulator for the antenna and array.

## II. Proposed Algorithm

*2.1 Rectangular Patch Antenna –*

Design section of a single microstrip antenna consists of patch, quarter wave transformer and feed line. A rectangular patch antenna is designed at 2.45 GHz frequency. A 50Ω surface mount adapter connector is used to connect the feed line to the coaxial cable. The feed line is fed to the patch through a matching network which is a quarter-wave transformer. The patch antenna with quarter-wave transformer is shown in Fig.1. The dimensions are calculated based on the transmission line model. The length and width of the patch are calculated using equations (1) and (2).

$$L = 0.49\frac{\lambda}{\sqrt{\varepsilon_r}} \quad (1)$$

$$W=\sqrt{\frac{90\frac{\varepsilon_r^{2}}{\varepsilon_r-1}}{Z_A}}\,L \quad (2)$$

$$Z_1 = \sqrt{Z_o R_{in}} \quad (3)$$

The impedance of the quarter wave line is calculated using equation (3). $Z_1$ is the transformer characteristic impedance. $Z_0$ is the characteristic impedance of the transmission line and $R_{in}$ is the edge resistance at resonance. The obtained values for the parameters are given in Fig.1 and Table 1

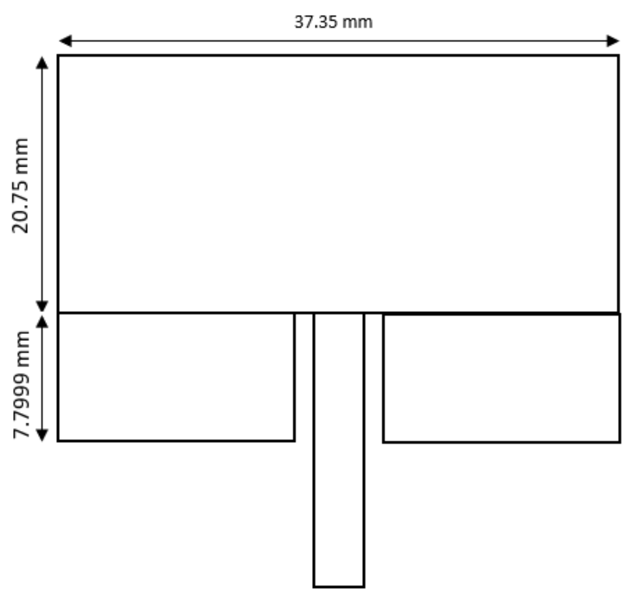


Figure 1. Patch Antenna Design Layout

*2.2. 1x2 Patch Antenna Array –*

The array antenna is used to increase the directivity. So the received power will be increased. In this proposed work, 1X2 patch antenna array is designed at 2.45 GHz frequency. The array calculation consists of two parts. The first is the patch calculation and the second is for 50 Ω, and 35 Ω transmission lines. Similarly the patch antenna dimensions are obtained from equations (1) and (2). The impedance of the quarter wave line transformer is calculated using equation (3). The obtained values for the line parameters are given in the Table 2 and Fig 2.

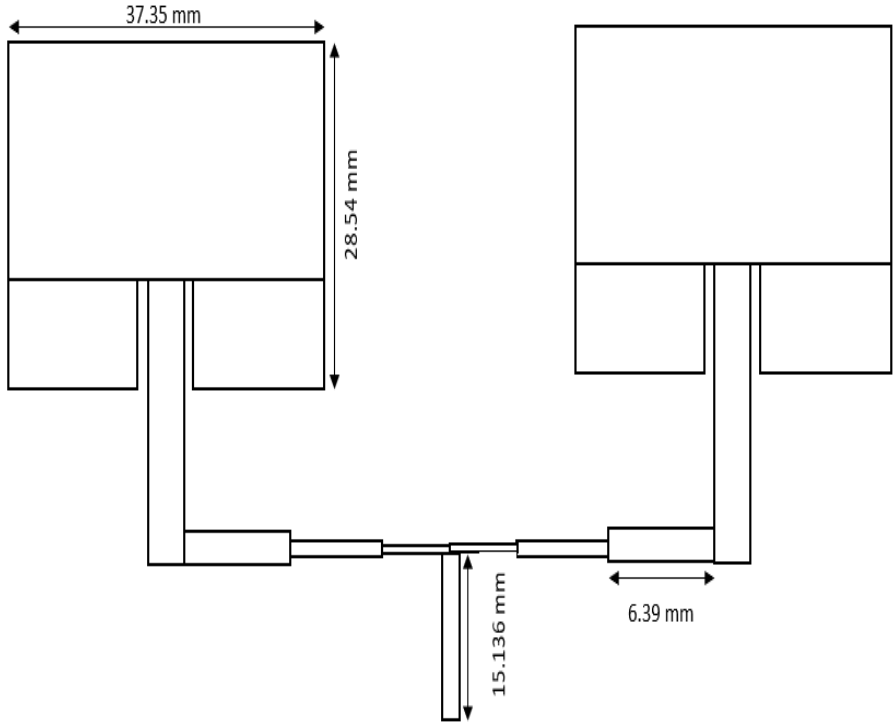


Figure 2. 1x2 Patch Antenna Design Layout

## III. Experiment and Result

Table -1 Dimensions of Rectangular Patch Antenna

| | |
|---|---|
| **Patch** | |
| **Width W** | **37.35 mm** |
| **Length L** | **28.54 mm** |
| **50 Ω Inset Feedline** | |
| **Width W** | **2.97 mm** |
| **Length L** | **22.93 mm** |

Table -1 Dimensions of 1x2 Rectangular Patch Antenna Array

| | |
|---|---|
| **Patch** | |
| **Width W** | **13.3 mm** |
| **Length L** | **19.97 mm** |
| **50 Ω Feedline** | |
| **Width W** | **2.95 mm** |
| **Length L** | **6.35 mm** |
| **35 Ω Feedline** | |
| **Width W** | **1.55 mm** |
| **Length L** | **18.173 mm** |

**Table 3 Comparison of Antenna Parameters**

| Parameters | Single Patch Antenna | 1X2 Patch Antenna Array |
|---|---|---|
| Gain | 5.77 dBi | 7.84 dBi |
| Directivity | 6.34 dBi | 8.38 dBi |
| Efficiency | 87.5 % | 88.27 % |
| Effective Angle | 2.91 Steradians | 1.82 Steradians |

## IV.CONCLUSION

The comparison of antenna parameters for single rectangular patch antenna and 1X2 rectangular patch antenna array at 2.45 GHz frequency is given in Table 3. From the tabulation values, it is observed that directivity, gain and efficiency are increased and also effective angle, is decreased for the array. So the simulated array obeys the antenna theory. The designed array may be suitable for Wi-Fi application.

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