Design and Analysis of an Antenna Array Based on a New Structure for an RFID Application

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***Abstract*— This paper proposes a new design microstrip patch antenna for RFID application; by applying microwave frequency band. The chosen resonance frequency is about 2.45 GHZ. A new design of the patch antenna parameters is calculated using theoretical equations, then verified by a simulation and optimization on CST MWS® software .The obtained results from simulation two antenna array simulations present a good impedance matching, and significant gain for this application.**

Keywords—Antenna, CST, microwave, Patch, RFID, Reader,

I. INTRODUCTION

The RFID (Radio Frequency Identification) reader antenna[1-2] allows the activation of tags and the transmission of information to the reader. It is one of the essential identification elements of RFID [3] system and its miniaturization and evaluation are of a great interest. In this work we are interested in microwave[4]technology, more particular in the design of a new structure of a patch antenna array[5] that radiates at 2.45 GHz for a RFID reader. These antennas are constituted of a FR4 type substrate (εr = 4.3, thickness =1.6 mm).

The structure of this array allows us to have better performances comparing to a rectangular patch antenna; where the main contribution of this technique is to help increase the gain of this antenna network [6] . We present in this study, the reflection coefficient and the radiation pattern of this array obtained by simulation by the CST MWS® [7]. A discussion of the performances, improvements and perspectives of this antenna structure concludes this work.

II. GEOMETRY AND STRUCTURE OF PROPOSED ANTENNA

This geometry is inspired from hexagonal antenna presented in [8], where we use PEC (Perfect Electrical Conductor) as radiating patch as shown in Fig. 1.

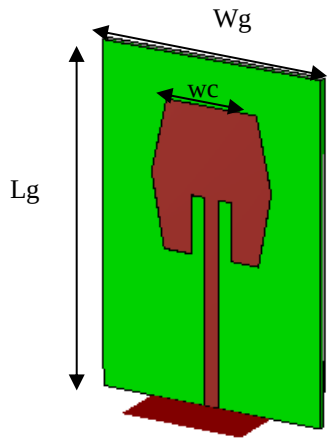

Fig. 1. Geometry of Antenna Design

TABLE 1: DIMENSION OF PATCH ANTENNA

Parameters	Dimensions (mm)
Substrate Length(Lg)	69.41
Substrate Width(Wg)	47.2
Patch Width(Wc)	9.75

The proposed patch antenna is designed with CST MWS®. Fig.2 shows the impedance matching result.

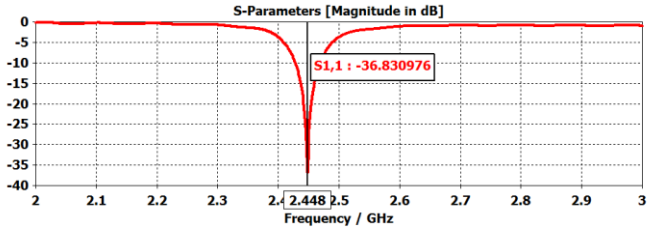

Fig. 2. The reflection Coefficient

From Fig.2, it is clear that hexagonal antenna has improved the performance of rectangular patch antenna work at the same resonance frequency. Where the value of return loss is less than -10 dB at 2.45 GHz, which means that a minimum return power can reflected at this frequency.

III. Simulation of an Array of Two Printed Antennas :

Fig.3 shows antenna array of two patch elements, separated by a distance d=0.6 mm, we opt for the parallel feeding method through a feed network in the form of a T-junction (power divider), where the characteristic impedance of the two microstrip lines is given as follows [9]:

$$Z0 = nZs \qquad (1)$$

The factor *n* is the number of microstrip transmission lines emanating from a node connected to a source generator. The characteristic impedance (Z1) of the two microstrip lines is given by Eq.1 as [9]:

$$Z1 = 2\,(50) = 100\,\Omega$$

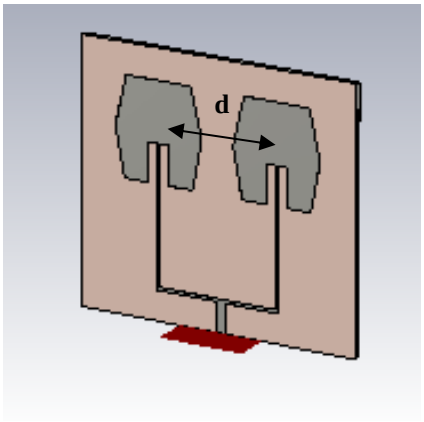

Fig.3. The patch Antenna Array

Reflection coefficient of the linear array of two patches is:

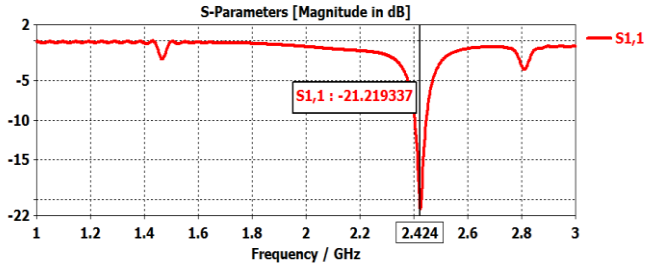

Fig.4. The Reflection Coefficient of a Two Elements Array Antenna

The Voltage Standing Wave Ratio of the linear array of two patches:

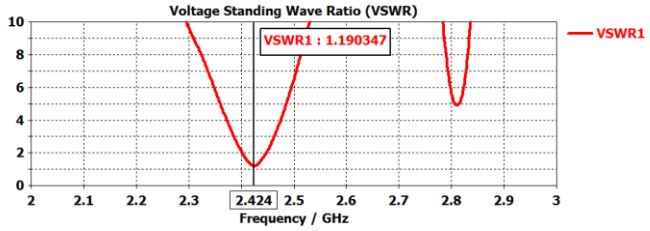

Fig.5. The VSWR Coefficient of Two Elements Array Antenna

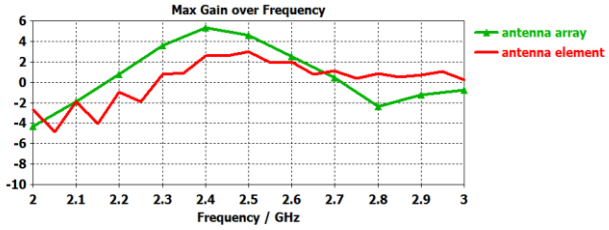

Fig.6. Gain Variation of Proposed Antenna Array

From Fig.6 we notice that the gain in a two parallel fed patches antenna array is improved compared to a single element antenna.

The 3D radiation pattern of a 2 patches array antenna reflects the value of the directivity, and on the polar plane graph which allows presenting the aperture of this antenna

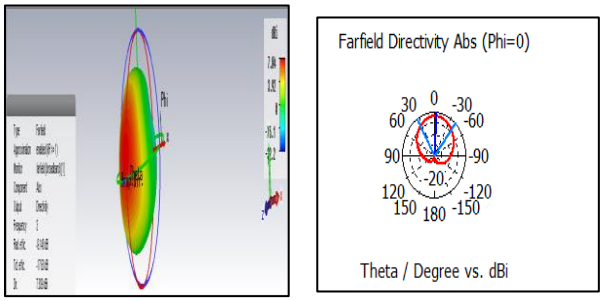

Fig.5.3D and Polar Directivity Radiation Pattern of a Patch Antenna

The obtained values from our proposed antenna are:

- The gain value is 5.14 dBi
- The directivity of this antenna is 7.83 dBi

- The aperture antenna is 75.8 deg.

It's very important to describe and present the reading range of RFID system; this parameter shows a distance of reading between the reader and the tag [11].

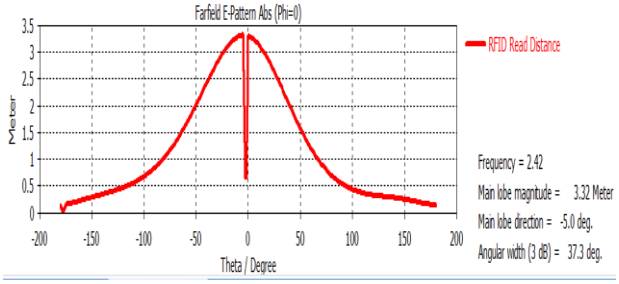

Fig.6.The RFID Reading Rang

TABLE.2.COMPARISON VALUES

	S11(dB)	VSWR(dB)	Gain(dB)	Directivity (dBi)
Single proposed patch antenna	-25.41	1.1133	2.79	6.142
Patch antenna array	-25.41	1.24	5.14	7.83

IV. CONCLUSION

we have simulated an antenna composed of two elements and the gain obtained is 5.14 dBi, this gain is improved by increasing the size of the network from 1 elements to 2 elements, in future works we will be interested in the realization of the antennas and the experimental validation antennas for RFID reader using network analyzer for measuring the reflection coefficient and the standing wave ratio.

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