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PERFORMANCE EVALUATION OF I- SHAPED PATCH WEARABLE TEXTILE ANTENNA IN LEATHER SUBSTRATE FOR 2.45GHz

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ABSTRACT

The aim of our work is to design an I-patch over textile substrates (soft substrates) instead of hard substrate such as RT Duroid and FR4 and to test its performance over ISM band (2.45GHz). Wearable textile antennas are current research for the ISM band. Electrical properties such as dielectric constant and loss tangent angle of various textile materials such as Leather, nylon, silk were considered for the design of I - patch is kept constant so that the various antenna parameters with different textile substrate also simulated and compared under the operating frequency of 2.45 GHz by using High Frequency Simulation Software (HFSS).

Ansoft HFSS is used for design and simulation of Leather substrate wearable textile I - shaped patch antenna**.**

Keywords: leather, substrate, high frequency simulation software (HFSS), I shape, ISM Band, patch antenna.

1. INTRODUCTION

Wireless technology is one of the main areas of research in the world of communication systems today and a study of communication systems is incomplete without an understanding of the operation of antennas. Textiles have emerged as promising material for an antenna substrate and its conductive parts in wearable application. There are many types of antenna available for different purposes and one of them which is widely used in wireless technologies are microstrip patch antenna. Due to its small size and higher efficiency over microwave frequencies (in terms of GHz) [9], patch antennas find a wider applications in various wireless technologies such Bluetooth, Zig Bee, Wi-Fi, WLAN and many more. Various wireless devices such as mobile phone, wireless routers etc use patch antennas over other antennas. The antenna requirements are given by the particular specification, light weight, inexpensive zero maintenance, no calibration and set-up and no damage from obstacles. Ina simple patch antenna will be one half wavelengths long. An electrically larger ground plane help to produce stable radiation pattern, but it will increase the size of the antenna.

One of the most popular printed resonant antenna for the narrow band microwave links which requires the semi hemisphere courage is the Microstrip antenna. The planer configuration and the size of integration purpose this antenna to be a compact structure. A patch antenna consists mainly three parts are ground, dielectric and patch. The patch is a metal of flat rectangular sheet and ground is a larger sheet of metal [10]. The antenna assembly usually protected with plastic radome.

IEEE 802.11 is the current standard for wireless local area networks (WLAN). It states to a family of specifications developed by the IEEE for wireless LAN (WLAN). 802.11 have four popular protocols: 802.11a, 802.11b, 802.11g, and 802.11n. They all operate at the 2.45GHz industrial, scientific and medical(ISM) band. 802.11a operates at the 5GHz while 802.11n operates at both 2.4GHz and 5GHz band [8].

IEEE 802.16 is known as Wireless Metropolitan Area Network (wireless MAN) and the module of this standard is called Worldwide Interoperability for Microwave Access (Wi-MAX) which falls under 802.16 d and 802.16 e. The 802.16 is a set of progressing IEEE standards that are allied to a vast array of spectrum extending from 2 to 66 GHz band. The most essential difference between WiMAX and Wi-Fi is that they are designed for totally different applications. Wi-Fi is the standard to provide sensible- to high-speed data communications within a short range, generally within a building. On the other hand, WiMAX is the standard to provide Internet access over a long range outdoor environment.

2. ANTENNA DESIGN

I - Patch

Width of the patch	: 60mm
Length of the patch	: 75mm
Height of the patch	: 5mm
Position of the patch	: -30mm,-37.5mm, 0mm

Leather substrate

Material of the substrate	: Leather
Dielectric Constant	: 1.8
Loss tangent	: 0.049
Length of the substrate	: 100mm
Width of the substrate	: 90mm
Height of the substrate	: 5mm
Position of the Substrate	:-50mm,-45mm, 0mm

Probe feeding

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Width of the Feed : 0.7mm
Length of the Feed : 5mm
Height of the Feed : -5mm
Position of the Feed : -25.7mm, -28mm, 5mm

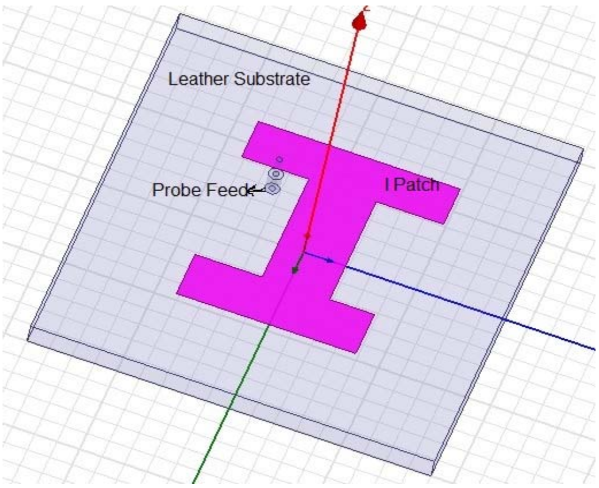

Figure-1. Structure of proposed I patch antenna.

3. SIMULATION AND RESULTS

There are different types of antenna parameters are simulated using High Frequency Simulation Software which are conducted in simulation environment. The Figure-1 shows that the structure of proposed I patch antenna and also it shows the type of feeding and substrate of the material.

3.1. Return loss

It is a parameter which indicates the amount of power that is "lost" to the load and does not return as a reflection. The graphical represented Figure-2 is shows that the return loss is -34 dB at 2.45 GHz and the proposed I patch antenna is single band narrow antenna.

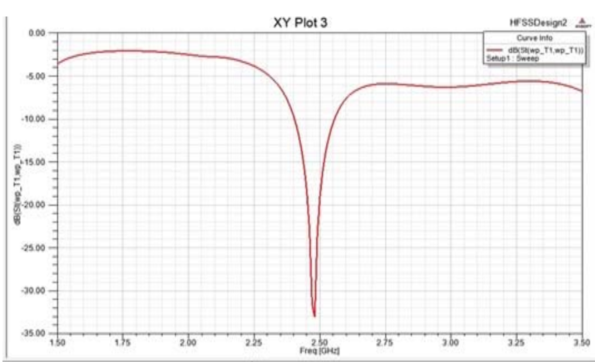

Figure-2. Return loss of I patch antenna.

3.2. Gain

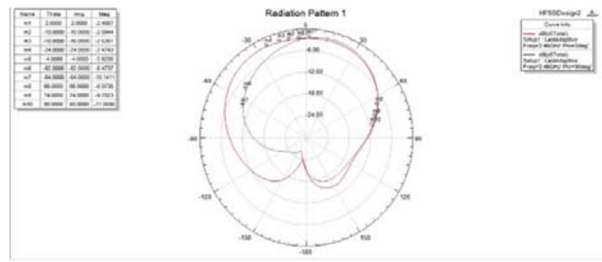

Figure-3. Gain of proposed I patch antenna.

3.3. Band width

From the obtained return loss Figure-2, the bandwidth of the antenna is measured at -10dB and it is from 2.45 GHz which is about -34db of the working frequency.

The band width is measured at -10 dB and it is showing on the below Figure m4 and m5, the difference between the two frequency at that particular point. In this project achieved a great value of 160 MHz bandwidth that is shown in the Figure-4.

This bandwidth value compared with existing patch antenna and the proposed bandwidth value. The proposed bandwidth is much better than rectangular patch antenna.

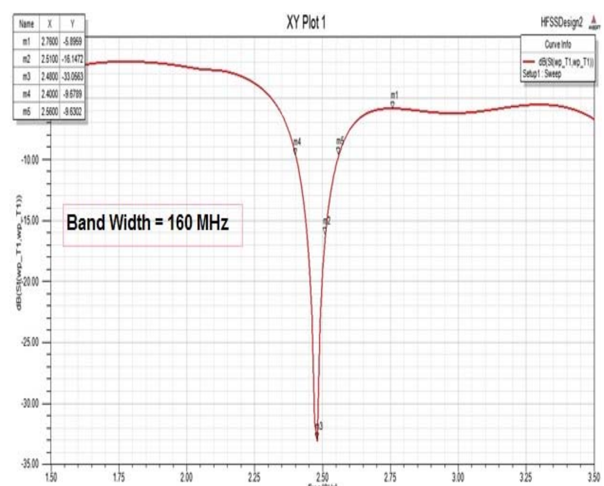

Figure-4. Bandwidth of proposed I patch antenna.

3.4. VSWR

The ratio of the maximum to minimum magnitudes of the voltage or current on the line having standing waves is called as the standing wave ratio or voltage standing wave ratio (VSWR). A standing wave is established while the transmission line is not matched to it is load so the transmitted power is reflected from a load. The voltage standing wave ratio is measured between

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transmitted powers that are reflected from the load. If the input impedance or source is equal to the output of the impedance or load, that is called as no reflection. For most antennas in WLAN, ISM band it is a measure of how close the antenna is to a perfect 50 Ohm. Figure-5 shows that the proposed I patch antenna VSWR value is equal to one. As per this VSWR graphical representation that proposed I patch antenna achieved best value of voltage standing wave ratio.

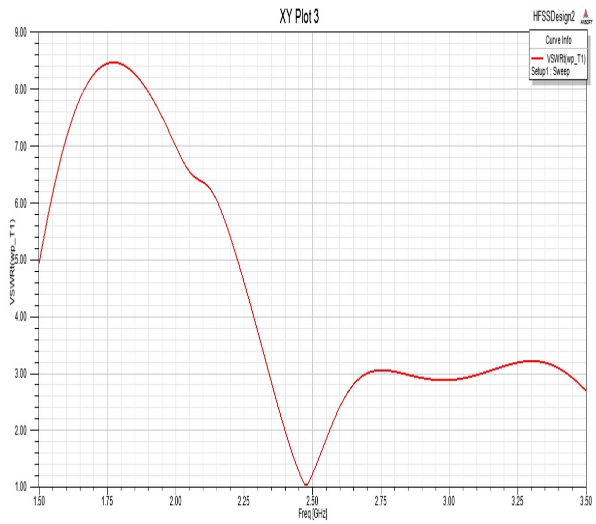

Figure-5. VSWR of proposed I patch antenna.

3.5. Radiation pattern

Gain is a measure, the ratio between power densities radiated in particular direction to the power density radiated in that direction by the reference antenna. When Phi =0 deg' proposed I patch antenna Gain= 4.7877 dB and when Phi =90 deg' proposed I patch antenna Gain = 5.16 dB at resonant frequency 2.45 GHz is shown in Figure 3. The Leather substrate I - Patch antenna 2D radiation pattern shown in below Figure-6.

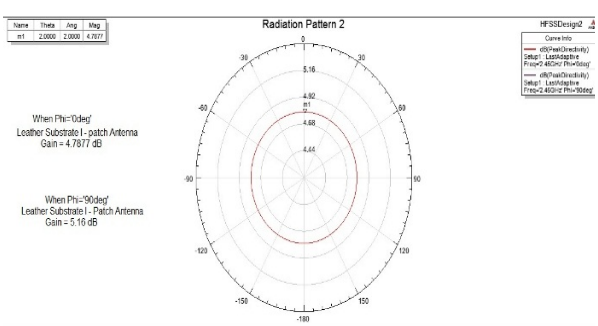

Figure-6. Radiation pattern of proposed I patch antenna.

3.6. 3D Radiation pattern

The Leather substrate I - Patch antenna 3D radiation pattern shown in below Figure-7, looks like a flatter "bagel" with a bantam "ball" wedged to the uppermost and lowermost.

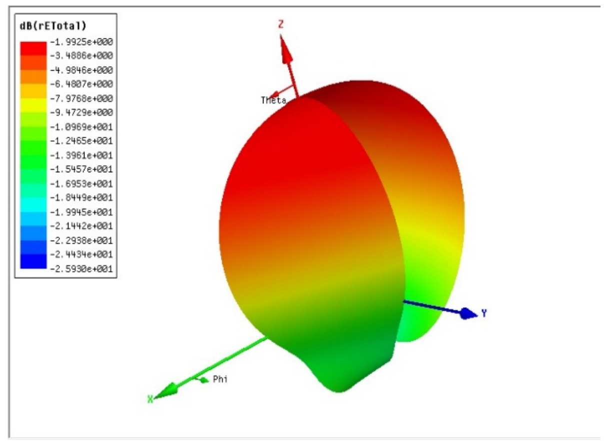

Figure-7. 3D Radiation pattern of proposed antenna.

4. CONCLUSIONS

This proposed novel I- patch wearable Leather substrate textile antenna is designed for Industrial, science and medical band that Microstrip patch antenna is very flexible and it is working at 2.45 GHz resonant frequency. When compared with other textile and hard substrates, leather gives the best return loss as -34 dB. This is shows that wearable textile material of Leather substrate I - patch antenna performed good when compared with other patch antenna at the resonant frequency of 2.45 GHz, ideally the return loss should be -∞dB, hence the antenna with leather substrate of wearable textile seem better.

In future, the proposed antenna can be fabricated and validated also it was suggested for following application, Medical Applications are identification, Pulse detection, and Cancer detection etc. Science Application is Mobile, WiFi, and Bluetooth. Industrial Application is Flaw Detection and Crack Detection in Metal Boilers.

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