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Design and Development of Wearable Antennas for Telemedicine Application

A.Abirami[1], B.Arulmozhi[2], S.Jenisha[3], B.karthika[4], S.Akila[5]

***Abstract*- This paper discusses design and parameters evaluation of Rectangular Microstrip Patch antenna for telemedicine application. A simple rectangular patch antenna is designed with three different substrates like wash cotton, silk and jean using inset feed technology. The results were obtained using Ansoft HFSS 13.0 software. The operating frequency of designed antenna is 2.7-2.8 GHz. The antenna is fabricated and tested using Vector Network Analyser. The fabricated antenna provided a return loss of -10.154dB for wash cotton.**

***Index Terms*- Microstrip patch antenna, dielectric loss tangent, VSWR, return loss.**

I. INTRODUCTION

Nowadays, Microstrip patch antennas are widely used in many applications due to their inherent advantages such as low profile, light weight, planar configuration and ease of fabrication. The antenna can be used as wearable [3] for many application. Wearable antennas can be integrated into the clothing of a person [11].Textile antenna is one of the most fascinating and cutting edge research areas of modern era. Body wearable antennas should be hidden and unconstructive [7].Wireless telemedicine especially suitable for areas lacking proper cable connections or places where installing cable links is difficult, economically unavailable or simply impossible [8].

In telemedicine applications there are many challenges for monitoring patients including the coverage reliability and quality of monitoring [2].One of the most difficult challenges in patient monitoring using wireless networks, especially for emergency message, is the reliability of message delivery [9].The antenna in which substrate was textile material, both antenna and ground plane are made of copper, the phenomenon of peeling off exists. When it is subjected to mechanical load [10].For a design of efficient wearable antenna we need to make trade off among different antenna parameters such as efficiency size and bandwidth [5].

A wearable microstrip patch antenna is of different kinds of shapes such as rectangular, circular, triangular. Among those, rectangular patch is using because of large surface area[1].Textile materials as substrates generally have very low dielectric constants, which reduces the surface wave losses and improves the impedance bandwidth of the antenna[3].For a good antenna performance, a thick dielectric substrate having a low dielectric constant is desirable. Since it provides better efficiency, larger bandwidth and better radiation and there configuration leads to a layer antenna size [7].From [12] the design equations for rectangular Microstrip antenna were obtained. The inset feed microstrip antenna provides impedance control with a planar feed configuration.

II.DESIGN

A microstrip patch antenna consists of radiating patch above the dielectric substrate and ground plane below the dielectric substrate. The first step for the design of the antenna is the selection of suitable materials for the antenna substrate, patch and ground plane. The design equations are given as

$$\lambda = c/f \qquad \therefore 0.003\lambda < h < 0.05\lambda$$

$$W_p = \frac{c}{2f_r}\sqrt{\frac{2}{\varepsilon_r+1}}$$

$$L_p = L_{eff} - 2\Delta L$$

$$L_{eff} = \frac{c}{2f_r\sqrt{\varepsilon_{reff}}}$$

$$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[1+12\frac{h}{w}\right]^{-1/2}$$

$$\Delta L = 0.412 \times h \times \frac{(\varepsilon_{reff}+0.3)\left(\frac{w}{h}+0.264\right)}{(\varepsilon_{reff}-0.258)\left(\frac{w}{h}+0.8\right)}$$

Where, Lp=Length of patch
Wp=Width of patch
ε=Dielectric constant
fr=Resonant frequency

Daily wear such as jean, cotton, silk are chosen as an substrate material for antenna. The standard permittivity values are used for the antenna design Then the patch and ground planes are made up of copper foil.

Thin copper foil is used for the conducting part due to its low surface resistivity and large temperature range and this enable us to solder the connector.

III.RESULTS AND ANALYSIS

Based on the theoretical expressions the calculation are made for different substrate materials such and jean ,cotton and silk and the simulation were carried out using HFSS software. Fig 1 shows as the return loss -11Db

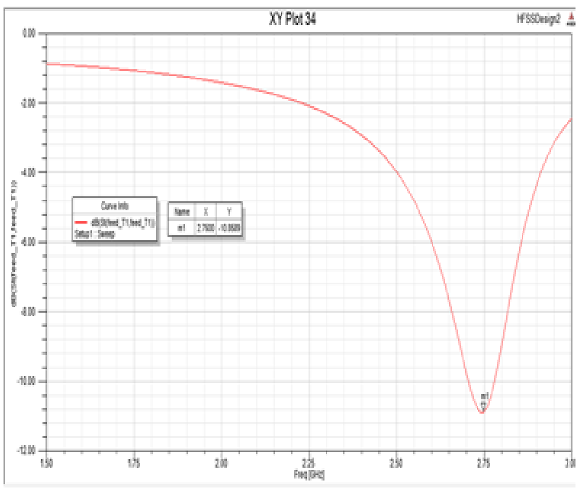


Fig 1:Return loss of wash cotton

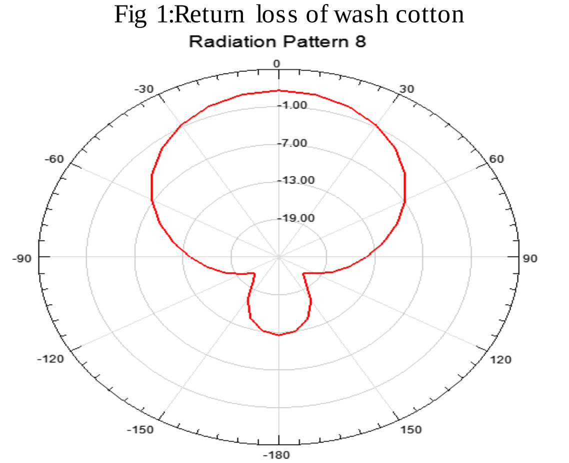


Fig 2:Radiatio pattern of wash cotton

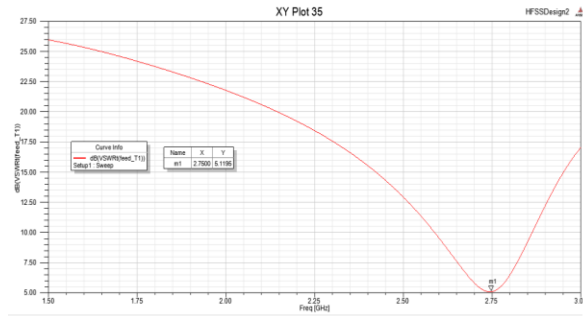


Fig 3:VSWR of wash cotton

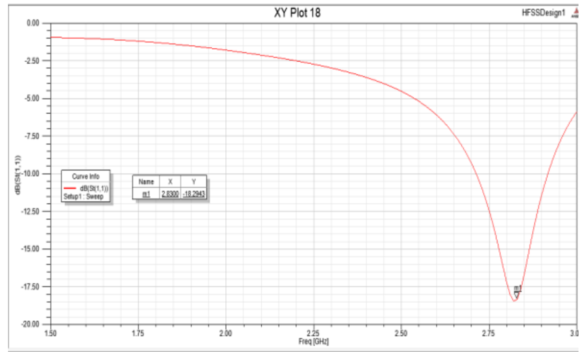


Fig 4:Return loss of Jean

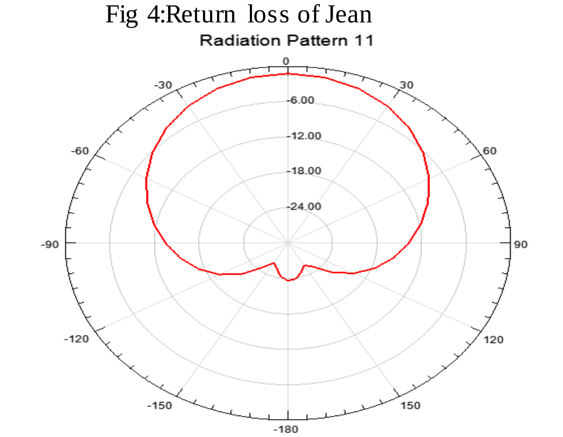


Fig 5 Radiation pattern of Jean

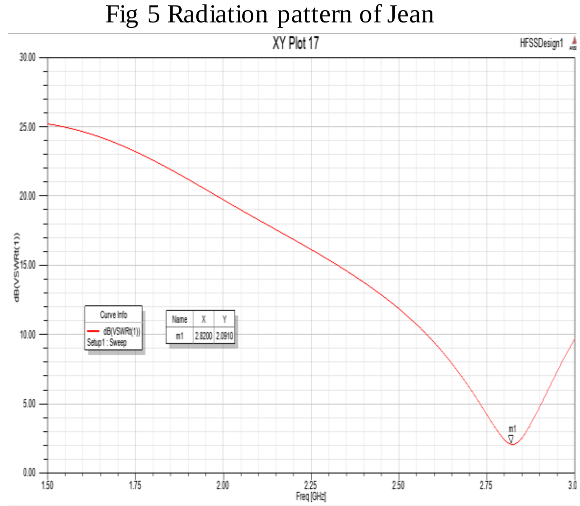


Fig 6:VSWR of Jean

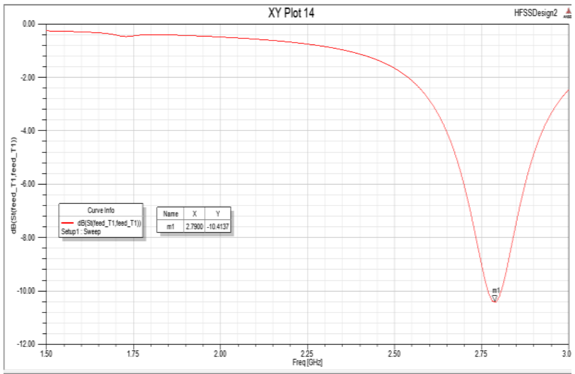


Fig 7:Return loss of Silk

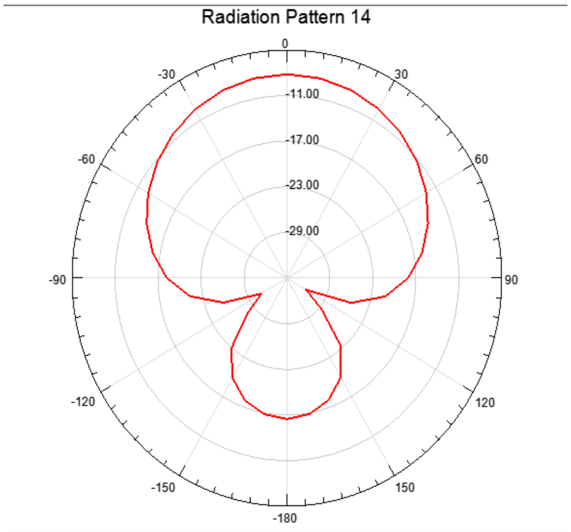


Fig 8:Radiation pattern of Silk

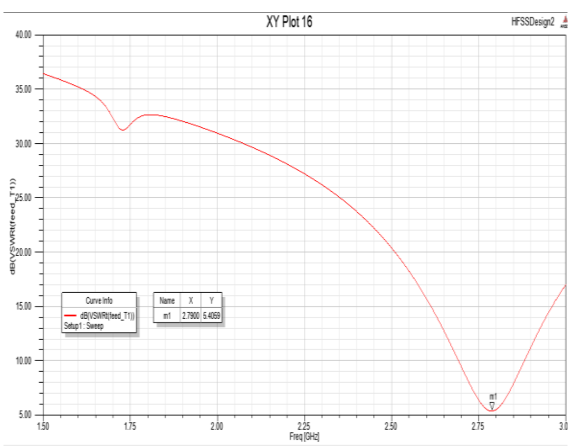
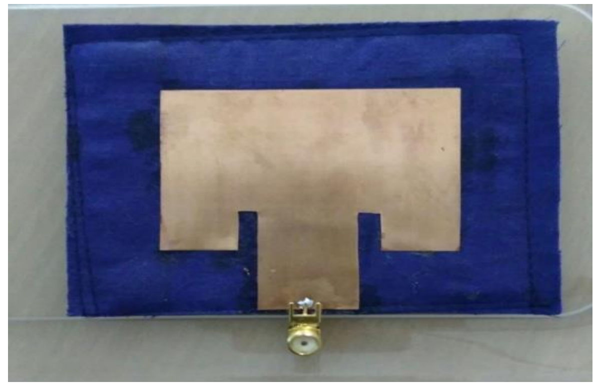


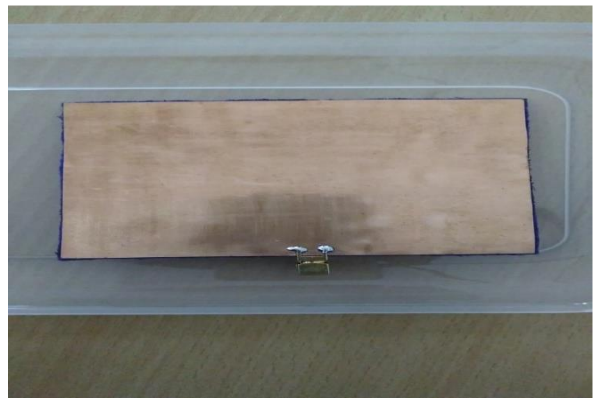
Fig 9:VSWR of Silk

IV.TEST AND MEASUREMENT

The antenna are stimulated and fabricated according to dimensions on a copper strip.



The ground plane length is shown in below figure

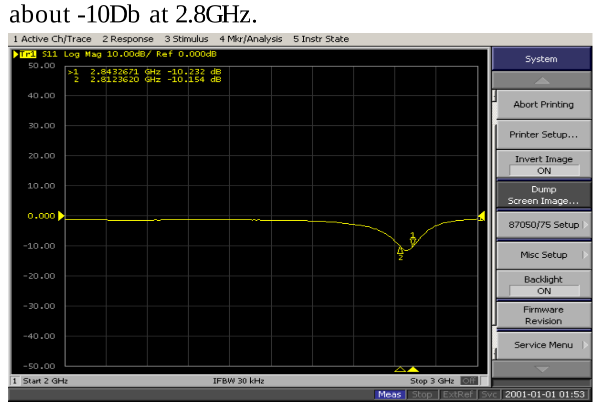


Here this antenna is fabricated and measurements is obtained through Vector Network Analyzer in normal room temperature with normal lighting.

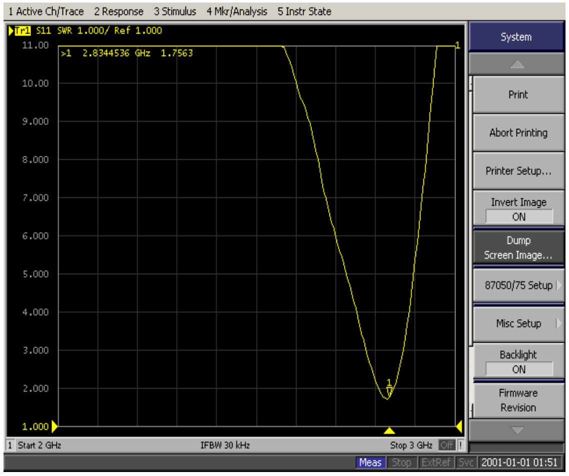
The design length of antenna is listed in below table\

PARAMETERS (mm)	WASH COTTON	JEAN	SILK
PATCH	45x56	45x54	28x37
SUBSTRATE	81x92	66x75	49x58
GROUND PLANE	81x92	66x75	49x58
HEIGHT	6	3.5	3.5

The return loss obtained for wash cotton substrate is about -10Db at 2.8GHz.



The VSWR for wash cotton is found to be 1.75



V.CONCLUSION

Three rectangular patch antenna has been designed for silk, cotton and jean substrate, out of which one antenna is developed and tested with the return loss of -10db of 2.8GHz is obtained for cotton substrate. Impedance matching of 50Ω is also obtained. The developed antenna is mainly used for collecting the body data signal for telemedicine application.

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