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A Body Wearable Antenna for Online Real-Time Health Monitoring System

[1] Mohd Kashif, [2] Zeeshan Ali Haq
[1] Jamia Hamdard, (Deemed to be University), New Delhi, India

Abstract - **Healthcare system in India is very fragile in a sense that that ratio between doctors and patients is very poor. Also, the medical cost is very high. In such situation, there arises a purpose of online health monitoring which would reduce the ratio and cut down on the medical cost. A textile antenna for online health monitoring is proposed in this paper. The antenna is designed to operate at 2.54 GHz frequency in ISM band. It will enable the patient to easily wear the system and transmit the real-time health monitoring data to the nearby hospital system. The ISM band ensures the license free data transmission over the channel. The designed antenna is a rectangular patch of wearable textile material.**

Index Terms — Health monitoring, real time monitoring, textile antenna

I. INTRODUCTION

Body sensors network helps in monitoring the body parameters such as blood pressure, blood sugar level, Heart rate, Pulse Rate to name few in order to keep a real time check on the health of a person. All this data is aggregated at the Central micro Controller Unit (CMCU). This aggregated data is processed at CMCU before being transmitted over the wireless channel to the nearby hospital constituting the Online Real-Time Health Monitoring System. This entire online real-time health monitoring system has the architecture as shown in figure 1. In the architecture shown below, S1, S2 and S3 are the health monitoring sensors placed on the body of the patient. These sensors acquire the data by constantly monitoring the vitals of the patient and disseminate that data at the controller unit, CMCU. Here the data is processed and then transmitted to the sink over the wireless channel. The sink is a base station which then decides which is the nearby hospital which needs to be informed about the patients condition and which hospital the patient can refer to.

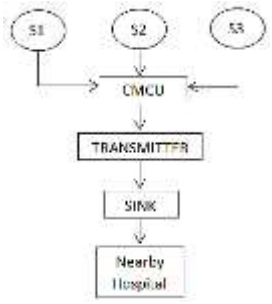

Figure 1: architecture of Online Real-Time Health Monitoring System

In all this system, Transmitter is a very important part as it is an electro-magnetic component and acts as a transducer which converts the electrical signal into an electro-magnetic wave. Also, this transmitter is to be situated on the human body for real time monitoring. Recently developments of devices which can be integrated with cloths are picking up interest of researchers [1]. Use of suitable materials such as textile and foams, this is becoming widespread. Patch antenna designed out of these materials has low profile. Such types of antennas are already incorporated in systems around for various applications such as health monitoring and military surveillance with satisfactory outcome [2-4]. In these antennas conductive textiles and metal foils are used as the radiating elements.

In the recent trend we have seen an increasing growth in the willingness towards the patch antenna due to theirs high compactness, low profile and inexpensive system as compared to their corresponding bigger antennas [5]. In this paper we have we have designed a textile based patch antenna which operates in ISM (industrial-scientific-medical) band [6-9] at a 2.54 GHz bandwidth where the compact antenna such as the proposed one is readily incorporated to reduce the size of the antenna and the cost as well.

This paper is divided into three sections. The first section comprises of the brief Introduction about the health monitoring system and transmitter as an important component of the system. The second sections discusses about the antenna design for the desired outcome of data transmission over the wireless channel. The third section discusses about the simulated result obtained after simulation on CST studio. The fourth and fifth section of

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the paper discusses about the conclusion and future scope of this proposed antenna

II. ANTENNA DESIGN

The size of the antenna patch is given by the following formula by using the knowledge in which band the patch antenna is supposed to work [10].

$$W = \frac{C}{2f_0\sqrt{\frac{\epsilon_r+1}{2}}}$$

Where W is the width of the patch, C is the speed of light, f0 is the operating frequency, εr is the dielectric constant. Also the effective length of the patch is given by

$$L_{eff} = \frac{C}{2f_0\sqrt{\epsilon_{reff}}} = L + 2\,\Delta L$$

The antenna has been designed for two parameters. Firstly, the operating frequency is kept constant at 2.54 GHz to be in the ISM band. Secondly, the input matching impedance of the patch antenna is kept at 50 Ω so as to keep the matching of feed line and the patch antenna perfect.

Table 1: parameters of proposed antenna for operating frequency of 2.54 GHz

S.No	Parameters	Dimension
1.	Operating Frequency	2.54 GHz
2.	Length of the substrate	45 mm
3.	Width of the substrate	35 mm
4.	Length of the Patch	20.06 mm
5.	Width of the Patch	25.4 mm
6.	Length of the microstrip feed line	21.42 mm
7.	Length of the vertical slot	1 mm
8.	Width of the vertical slot	8.46 mm
9.	Length of the horizontal slot	6.58 mm
10.	Width of the horizontal slot	1.27 mm

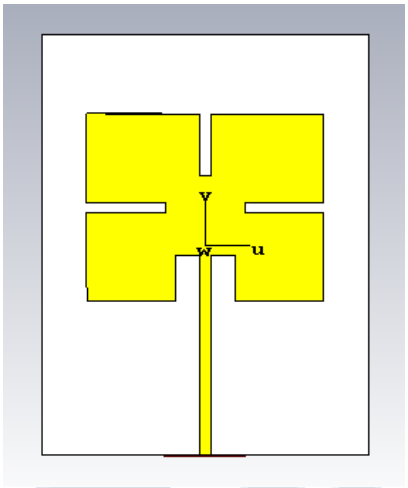

Figure 2: Proposed antenna design

III. RESULT & DISCUSSION

The design, proposed above has been simulated using CST tool. The model has been designed for operating frequency of 2.54 GHz. In the simulation result, we can see that at the operating frequency, the return loss (a parameter explained above) has a value of -44 dB. This means that 0.0063 times of input power is reflected back to the patch of the antenna. The lesser the amount of power reflected back, more the power is reflected into the surrounding which also helps in improving the directivity and gain of the antenna.

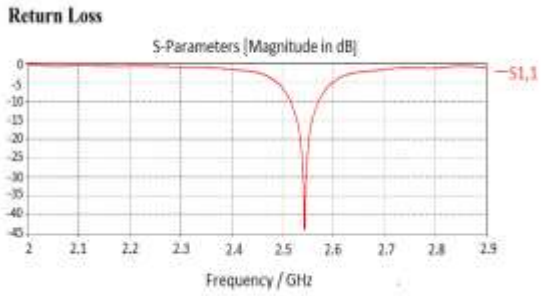

Figure 3: Return Loss of the proposed antenna

Again for the simulated result we calculate the directivity of the designed antenna. This directivity comes out to be 5.642 dBi. The directivity of the antenna talks about the radiation pattern of the antenna. If we want to transmit the signal from one point to another, directivity plays an important role in deciding the amount of power being directed in a direction towards the receiving antenna. In

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the simulated result, the result of 5.642 dBi is good and can further be improved by modifying the design parameters.

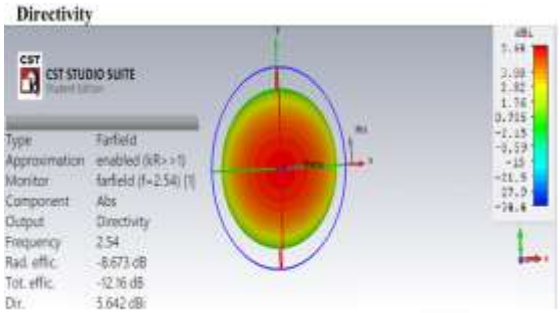

Figure 4: Farfield result for simulated antenna

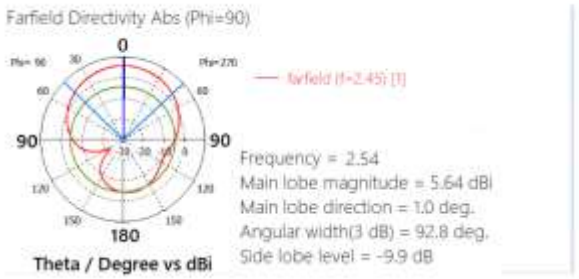

Figure 5: Directivity of the microstrip patch antenna

IV CONCLUSION

The proposed antenna for the online real-time Health Monitoring system has been designed using CST Studio. The return loss for the proposed antenna at 2.54 GHz is -44 dB which is 10% higher than the proposed antenna of [11] for the same application. The directivity of proposed antenna is found to be 5.642 dBi

V FUTURE WORK

Further enhancing this work, we need to incorporate this design antenna with the monitoring system so as to transmit the data to the sink. For this purpose, the antenna has to be implanted on the textile material to be worn on the body of the patient. This antenna has to be operated using the central processing unit which feeds the antenna with the aggregated data for data dissemination. This will lead to proper implantation of the system and reducing the medical cost at higher efficiency of patient monitoring in real time.

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