Design of Implantable Antenna for Patient monitoring system

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Abstract: We present a low cost implantable antenna for wireless medical application especially for patient monitoring. The antenna is a patch antenna with a dielectric Superstrate. It is designed for an Industrial Scientific and medical band (ISM) (2.4 -2.5 GHz) and communication band (3.25GHz) application. From the simulated results, it is seen that $|s_{11}|$ is less than -10dB in the operating frequency. This provides an Omnidirectional Pattern. The key factors like gain and directivity is also obtained.

Keywords- implantable antenna: ISM (industrial scientific and medical) band:low cost.

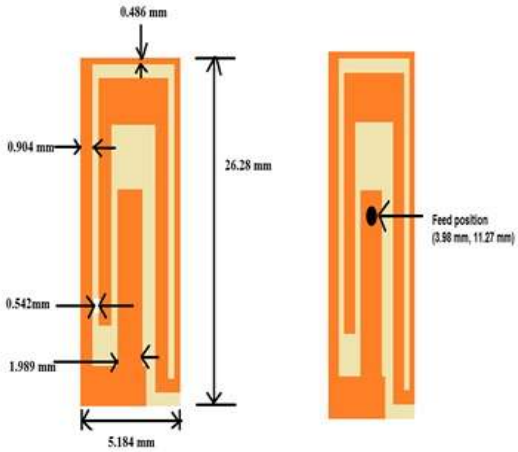
1.INTRODUCTION:

Presently, the medical technology involving in the reduction of complexity in the treatment process. To overcome the problems in wired technology in medical field the wireless telemetry system is now days used. The medical device is used to detect the various parameters like glucose levels, temperature, Heart rate, etc. There are three types of communication off body, on body, in body communication. Off body communication which refers to the communication outside the body. On body communication deals with antenna fixed on the surface of the body, example textile antenna. The In body communication deals with the antenna which is placed inside the body, example implantable antenna. The implantable antenna can plays a vital role in wireless medical communication and it can be used in two ways as a sensor antenna and simple Antenna. When an Implantable antenna is placed in human body, based on the permittivity of muscles, the radiation pattern of an antenna changes in this manner it act as an sensor antenna. The permittivity varies for every person. Based on this change the radiation pattern also Varies, by comparing the defect person's radiation pattern with the standard radiation pattern, We can calculate the above mentioned body parameters. The simple antenna produce a radiation pattern based on the sensor output. Implanted antenna is an miniature sized antenna. As we referred our Base Paper they used the material called Rogers, having permittivity(10.2). They obtain single band frequency of 402-405 MHz (MICS band) in simulation and two medical band during Fabrication in the frequency range of 402-405 MHz (MICS band) 2.4-2.48GHz (industrial scientific and medical band : ISM band) and they use HFSS simulation tool. The proposed

antenna will be analyzed by using Computer simulation tool (CST). In this design we create a internal loop, here substrate used is Fr4 having the permittivity of 4.6 at low cost compare to rogers. In simulation there obtain two bands at the range of (2.45GHz and 3.25GHz).CST is an 3D plot which is for low and medium frequency range. It uses the perfect boundary Approximation method. The range of simulation methods in CST MWS allows the engineer to choose the best technique for each application. The transient solver could be best for wideband or planar antennas, the frequency domain solver may be more suitable for electrically small antennas, while the integral equation solver can efficiently simulate electrically large or wire antennas.
It is fast, accurate and easy to use.

II. STRUCTURE ANALYSIS

The structure of implantable antenna is discussed. It is shown in Fig. 1 (a) and (b). There are two monopole with an Interior loop responded to low frequency(2.45GHz) and high frequency (3.25GHz)bands, respectively. The dielectric superstrate is employed to reduce the total size of the antenna thus it consists of two layers of dielectric superstrate and substrate, respectively. The printed circuit board (PCB) of Fr4 is used in the design, where it has a relative permittivity (ε_r) equal to 4.6 and the thickness is 1.6 mm. The feed is given at a position of (3.98mm,11.27mm). The antenna characteristic is evaluated by the CST simulation software



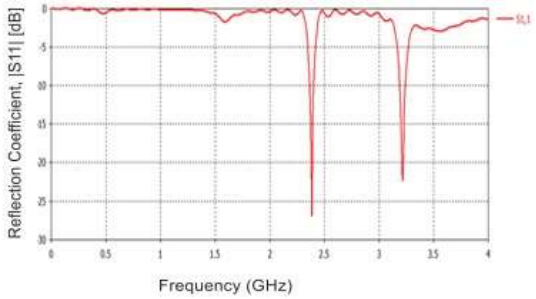
1 (a) Dimension of Proposed Antenna

1 (b) Feeding point of Proposed Antenna

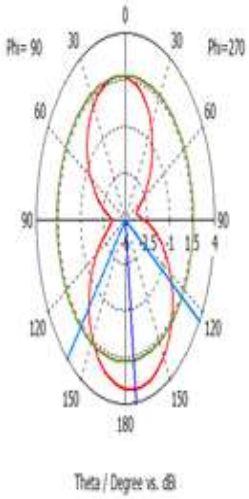
III.SIMULATION RESULTS:

In this paper, figure 2(a) shows S_{11} result 2(b) shows directivity and 2(c) shows gain plot. There will be no side lobe and back lobe hence there is no backward radiation. The reflection coefficient is attained below -10 dB which is an efficient result. Maximum Directivity of an implantable is 1.5 in this paper the directivity is minimum since it radiates in omni-directional pattern. The gain is a combination of directivity and efficiency. Here the efficiency is less for miniature size antenna. Since the impedance match is poor and body act as a resistive load.

We got improved gain when compared to previous result.



2 (a) Antenna reflection coefficient S_{11}



2 (b) Directivity of an Antenna

IV. CONCLUSIONS

The implantable patch antenna with a dielectric superstrate can be effectively used in wireless medical applications . From simulated results, it shown that it can be operated in the frequency of 2.45GHz and 3.25GHz.

FUTURE SCOPE

There is an possibility of obtaining multibands when it is Fabricated and Tested. Implantable antenna is used for testing the glucose level,Heart rate,Blood Pressure. The result can also obtained from the Wifi connected devices.

2 (c) Antenna Gain plot

REFERENCES

[1] saharat surapan,supakit kawdundta,Hung-Chi Yang,chih - Kuang Wu,"Design of dual band Implantable antenna for biomedical applications" 2016

[2] C.-M. Lee, T.-C. Yo, F.-J. Huang and C.-H. Luo, "Dual resonance π- shape with double L-strips PIFA for implantable biotelemetry," *Electronics Letters*, vol. 44, no. 14, pp. 837-838, July 2008.

[3] T.-F. Chien, C.-M. Cheng, H.-C. Yang, J.-W. Jiang and C.-H. Luo, "Development of nonsuperstrate implantable low-profile CPW-fed ceramic antenna," *IEEE Antenn. Wireless Propag. Lett.*, vol. 9, pp. 599-602, Jun. 2010.

[4] T. Karacolak, A. Z. Hood and E. Topsakal, "Design of a dual-band implantable antenna and development of skin mimicking gels for continuous glucose monitoring," *IEEE Trans. Microwave Theory Tech.*, vol. 56, no. 4, pp. 1001-1008, Apr. 2008.

[5] T. Karacolak, R. Cooper and E. Topsakal, "Electrical properties of rat skin and design of implantable antennas for medical wireless telemetry," *IEEE Trans. Antennas Propag.*, vol. 57, no. 9, pp. 2806-2812, Sept. 2009.

[6] T. Karacolak, R. Cooper, J. Butler, S. Fisher and E. Topsakal, "In vivo verification of implantable antennas using rats as model animals," *IEEE Antennas Wireless Propag. Lett.*, vol. 9, pp. 334-337, Apr. 2010.

[7] T. Yilmaz, T. Karacolak and E. Topsakal, "Characterization and testing of a skin mimicking material for implantable antennas operating at ISM band (2.4 GHz-2.48 GHz)," *IEEE Antennas Wireless Propag. Lett.*, vol.7, pp. 418-420, Jun. 2008.