Design of An Ultra Wideband Antenna for Non-Contact Respiratory Monitoring

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***Abstract*—Non contact respiratory monitoring is the development of wireless communication systems in telemedicine. A key component of non-contact respiratory monitoring is an antenna. The antenna must be lightweight so that it is compatible with other supporting system components. The paper presents the design of an optimized radiating element that satisfies challenging requirements: ultra wide-band (UWB), directive radiation pattern, small dimensions (in order to reduce its invasiveness) and low cost for realization.**

Index Terms—Non contact respiratory monitoring;UWB; antenna.

I. INTRODUCTION

Non-contact respiratory monitoring is the development of an electrocardiogram (ECG) commonly used in a hospital. ECG technology records the repiration rate with the electrode plate that connected with cables that will limit the user's movement and electrodes can cause irritation [1]. So, non-contact respiratory monitoring is a solution because it does not require direct contact with users. Non contact respiratory monitoring uses ultra wide-band impulse-radio (UWB IR) technology. Ultra-wideband impulse-radio (UWB-IR) is expected to detect the small respiratory movement of human body, which is very unique as compared with conventional monitoring sensors [2].

UWB has several advantages for the medical field including:does not require direct contact with the skin,non-ionizing so it is safe when penetrating biological tissue, low power, portable and low cost [3].

A key component of non-contact respiratory monitoring is an antenna. Antenna for non-contact respiratory monitoring applications must be compact, wide bandwidth, unidirectional polaradiation and low cost [4]. Microstrip antennas are suitable for non-contact respiratory monitoring because they are compact and easy to make. According to the Federal Communications Commission (US-FCC) in 2002 regulations issued a signal categorized as UWB had signal bandwidth greater than 500 MHz [5].

So, this paper will design an antenna with a standard bandwidth set by the FCC.

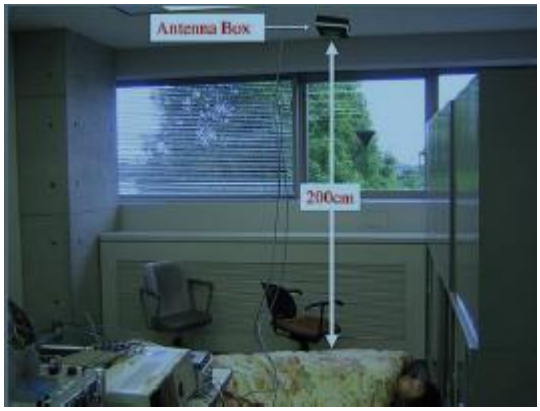


Fig. 1. Non Contact Respiratory Monitoring.

II. ANTENNA DESIGN AND ANALYSIS

A. First Antenna Model

The microstrip antenna to be simulated operates at a frequency of 5.8 GHz with bandwidth is greater than 500 MHz. The return loss and VSWR is planned to be under than -10 dB and 2 respectively, Epoxy FR-4 substrate (εr =4.6) with thickness (h) 1.6 mm, copper conductor, impedance of the Z_0 transmission line and proximity-coupled,and patch rectangular.

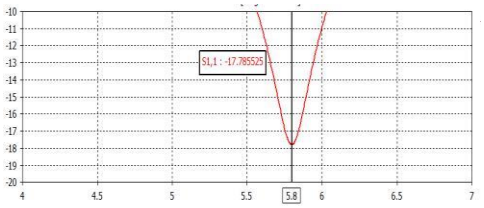


Fig. 2. Returnloss First Antenna.

The result of the initial antenna has had return loss about -17,78 dB and bandwidth about 463.3 MHz. And gain 4,767 dB.

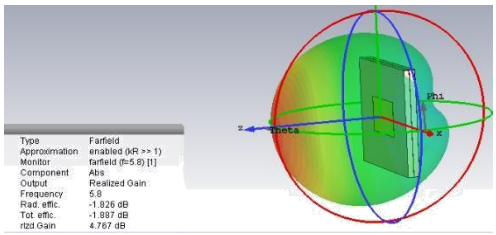
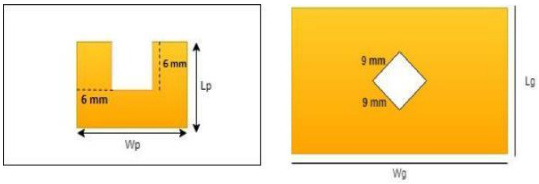


Fig. 3. Gain First Antenna.

Furthermore, increasing the antenna bandwidth until it fulfill the UWB standard has been done by modifying the shape of the resonator which will be explained in next sub-chapter.

B. Final Antenna Model

The antenna is formed into U patch, and the groundplane has a diamond shaped slot. The size can be seen in Fig. 3.



(a) (b)

Fig. 4. Design of Microstrip U Patch Proximity Coupled with DGS slot: (a) Front side of Antenna.

(b) Rear side of Antenna

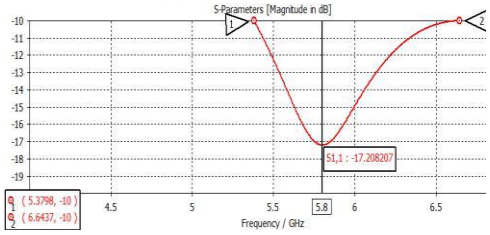


Fig. 5. Returnloss Final Antenna.

Final Antenna has returnloss of -17.2 dB, bandwidth of 1264 GHz, the UWB bandwidth standard has been reached and gain of 4.477 dB.

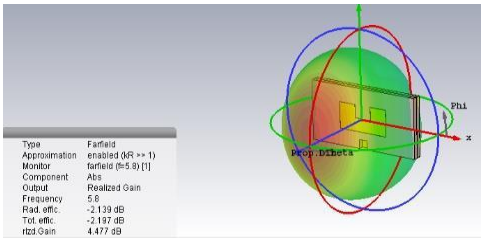


Fig. 6. Gain Final Antenna.

Table 1. Comparison of First Antenna Parameters and Final Antenna

Parameters	First Antenna Model	Final Antenna Model
Returnloss (dB)	-17,78	-17,2
VSWR	1,296	1,32
Bandwidth (GHz)	0,4633	1264
Gain (dB)	4,767	4,477

From table 1, it can be concluded that with the U patch and DGS slots on the groundplane bandwidth increases by 800.7 MHz.

III. CONCLUSION

Antenna for non-contact respiratory monitoring has been simulated. With a center frequency of 5.8 GHz, a bandwidth of 1264 GHz which is more than the standard UWB, and unidirectional polaradiation. This antenna is 40x20 mm in size, so it is small and compatible with other supporting devices. Most importantly the antenna reduced dimensions and the low cost for its realization.

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