A Compact UWB Antenna Design for Breast Cancer detection

UdayamoorthyVenkateshkumar¹, Yamunadevi S¹, YogithaU¹, Ponraj S¹
¹ECE Department, Sri Krishna College of Technology, Coimbatore, India.
u.venkateshkumar@skct.edu.in, yamunadevisengottuvel@gmail.com,
yogithaudayakumar25@gmail.com, 30ponrajspz@gmail.com

Abstract. There are many diseases in the world. The most common and dangerous disease is cancer and the number of cancer patients is increasing and the number of deaths also increased. If we detect the cancer at early stages, we can be able to reduce the deaths. In this paper, a rectangular fix receiving wire is intended to identify the disease at beginning phases and this increment the higher opportunity to recuperate from disease. The compact low profile wearable antenna is used to detect cancer. Microstrip patch antenna is used in this project because of low profile, low cost, miniaturization of antenna, high bandwidth and high gain. This antenna is compact because, IR can be easily fabricated on the printed circuit board unlike other antennas. The square fix is utilized to defeat the complex construction.

Keywords: ultrawideband, breast cancer, gain, VSWR.

1. Introduction

Breast cancer is the most well-known dangerous tumor without skin and the subsequent driving reason for death in ladies around the world. This sort of malignant growth influences almost 2 million patients consistently, and a huge number of ladies bite the dust from the illness. Early recognition is viewed as the best expect diminishing genuine fatalities until research tells the best way to forestall bosom malignancy or treat all ladies. Early recognition of malignant growth with screening tests lessens disease mortality. Fifty years prior, there was no grounded technique for the early location of bosom malignant growth, yet propels in innovation and law have upset the circumstance. The utilization of X-rays for bosom identification was first proposed, and mammography was not an acknowledged procedure until the 1960s.

Interest in breast malignancy research, including early determination, has expanded essentially ridiculous decade. New or better advancements are arising quickly, offering expect early recognition. X-beam mammography has demonstrated to be the best device and assumes a significant part in the early recognition of bosom disease. Contrasted with other screening techniques, the achievement rate is high, yet X-beam mammography likewise has limits. Because of the badly arranged chest pressure related with this symptomatic strategy, patients couldn't be tried early and both bogus positive and negative outcomes were accounted for, so an elective screening test was presented. Another problem with the use of X-ray mammography is the amount of radiation emitted by the ionizing X-ray. All these disadvantages motivate you to look for the best solution. One of the researched options is microwave imaging. Microwave innovation is progressively utilized for demonstrative purposes in
biomedical designing. In light of changes in hereditary properties, this technique guarantees nondangerous evaluation of natural tissue that makes pictures related with the electrical properties of bosom tissue. This is because tissues with malignant tumors have a higher moisture content than normal breast tissue and therefore have higher genetic properties than normal tissues with a lower moisture content, which is why microwaves are considered malignant tumors. Different uses of microwave imaging have been noted in the clinical field and are utilized to distinguish bosom malignancy. Antennas are a vital component of any microwave imaging framework, imparting and accepting signs to and from close by objects. This application is like GPR, however works at high frequencies. An assortment of wideband (WB) and ultra wideband (UWB) reception apparatuses have been proposed for microwave imaging. Most antennas accessible in the literature discharge low addition omnidirectional radiation. This kind of antennas is reasonable for indoor and open air correspondence over brief distances. Nonetheless, for microwave imaging frameworks utilized for a medical procedure and discovery of bosom tumors, it very well might be alluring to utilize a high increase direct antennas. In this article, a level metal sheet receiving antenna is introduced related to a roundabout plate mounted on two vertical rectangular plates. The antenna was created utilizing HFSS(High Frequency Structure)Software.

2. Literature survey
Assessed the Impact of National Health Service Cancer Screening Program on Breast Cancer Mortality in Women 55-69 years, 1990-1198 [1]. Have built up a little antennas for identifying crossenergized reflections and utilization of a receiving wire for distinguishing bosom malignant growth utilizing radar [2]. Designed a square antenna printed with half a ground plane and microwave powered for UWB applications [3]. U-shaped single-ended antennas powered by coplanar waveguides is designed with low profile and the size is also very small [4]. An antenna with an optimized impedance have been shown to emit pulses into the bow-tie more like excitation than a metallic bowtie of similar size [5]. Compared the antenna to a resistively loaded flat dipole commonly used for GPR and demonstrated the performance of the antenna produces a clear B-scan image that makes it easy to observe details on a shallow surface [6]. Dielectric-filled UWB antennas are designed to detect breast cancer. The antenna geometry is a modified version of a sticky hybrid immersed in a dielectric medium and driven by an integrated ultrawideband balun [7]. A small monopole microband antenna was designed and antenna parameters such as return loss, dc ratio, radiation pattern, and group delay were measured several times to verify the simulation and acknowledge reception [8]. Developed a compact, low profile pendant antenna that can quickly and inexpensively detect breast cancer at an early stage and display tumors on a screen [9]. Developed Microband patch antennas with specifications and applications for breast tumour detection [10]. Developed a breast cancer detecting system that can predict the types of tumor cells present in the breast volume will facilitate early clinical diagnosis for patients [11].

3. Antenna Design and Fabrication
The antenna on the ground plane of estimation L = W = 40mm and thickness h= 0.5 mm. Where L= Length of the patch and h= height of the substrate. The length is determined using the formula

\[ L = \frac{c_0}{2f_0 \sqrt{\varepsilon_r \varepsilon_{eff}}} - 2\Delta L \tag{1} \]

and width \( W = \frac{c_0}{f_r \sqrt{\varepsilon_r}} \tag{2} \)
The effective refractive index is given by

\[
\varepsilon_{\text{reff}} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2} \left[ 1 + \frac{3}{2} \left( \frac{W}{h} \right)^2 \right] W \quad \text{where } h > 1
\]

The actual length \( \Delta L \) of the patch

\[
\Delta L = \frac{\varepsilon_{\text{reff}} + 0.3}{\varepsilon_{\text{reff}} + 0.264} \left( \frac{L}{h} + 0.264 \right) = 0.412
\]

The ground plane width and length is given by

\[
\begin{align*}
L_g &= 6h + L \\
W_g &= 6h + w
\end{align*}
\]

The reception apparatus is taken care of by vertical plate of most extreme tallness 5mm and width of 15 mm, in which it is associated with the taking care of test through the space of 4mm measurement in the ground plane in equation 1-5. The antenna is designed by using high frequency structure simulator (HFSS). Microstrip feed line is used for excitation. The plan of the antenna is appeared in figure 1. The gain of the antenna is appeared in figure 2 that is 5.7ghz. Polar plot is appeared in figure 3. The radiation pattern of antenna fulfilled the omni directional pattern. There are 3 radiation designs that are appeared in figure 4, figure 5 also, figure 6. The return loss is appeared in figure 7. The return loss accomplished by the antenna is –22 dB. VSWR worth ought to be under 2. The VSWR accomplished by the antenna is 1.6. It is the proportion between the most extreme voltage to least voltage. It is shown in figure 8.

Figure 1. Design of proposed antenna
In this antenna we used the substrate FR4 epoxy. The rectangular patch is used to avoid complex structure and make a profile. To excite the antenna micro-strip feed line is used. We used IR to fabricate the antenna. So the antenna is very compact. Thus the antenna is analyzed and designed.

4. Results and discussion

![Figure 2. Gain](image1)

![Figure 3. Directivity](image2)

![Figure 4. Radiation pattern 1](image3)
Figure 5. Radiation pattern 2

Figure 6. Radiation pattern 3

Figure 7. XY Plot

Figure 8. VSWR for proposed antenna
5. Conclusion

The new conservative UWB radio wire configuration has been introduced. The effect of the different radio wire boundaries on the data transfer capacity and the reverberation trademark were examined. The working data transfer capacity of the receiving wire at a least serviceable return deficiency of 10 dB accomplished was 3.5 GHz to 8 GHz. The estimation results show a decent concurrence with the reproduced one. The receiving wire displayed great directional radiation design with satisfactory addition of 8 dB over the majority of the UWB considered as liked for imaging application.

References

[1] Blanks, R. G., S. M. Moss, C. E. McGahan, M. J. Quinn, and P. J. Babb, Effect of NHS breast screening programme on mortality from breast cancer in England and Wales, 1990-8: Comparison of observed with predicted mortality, 665-669, 2000.
[2] Yun, X., E. C. Fear, and R. H. Johnston, Compact antenna for radar-based breast cancer detection, IEEE Trans. Antenna Propagat., Vol. 53, 2374-2380, Aug. 2005.
[3] Ngah, R., Y. Rahayu, T. Prakoso, and M. S. Othman, Printed square UWB antenna, International Conference on Electrical Engineering and Informatics, 972{975, Institut Teknologi Bandung, Indonesia, 2007.
[4] D. Devikanniga, A. Ramu, and A. Haldorai, Efficient Diagnosis of Liver Disease using Support Vector Machine Optimized with Crows Search Algorithm, EAI Endorsed Transactions on Energy Web, p. 164177, Jul. 2018, doi:10.4108/eai.13-7-2018.164177
[5] H. Anandakumar and K. Umamaheswari, Supervised machine learning techniques in cognitive radio networks during cooperative spectrum handovers, Cluster Computing, vol. 20, no. 2, pp. 1505–1515, Mar. 2017.
[6] Lestari, A. A., D. Yulian, L. A. B. Suksmono, E. Bharata, A. G. Yarovoy, and L. P. Ligthart, Improved bow-tie antenna for pulse radiation and its implementation in a GPR survey, 2007 4th International Workshop on Advanced Ground Penetrating Radar, 197-202, June 2007.
[7] Shannon, C. J., A dielectric filled slotline bowtie antenna for breast cancer detection, M. Sc. Thesis, The University of Calgary, Alberta, Canada, September 2004.
[8] Hossain, I., S. Noghanian, and S. Pistorius, A diamond shaped small planar ultra wide band (UWB) antenna for microwave imaging purpose, 2007 IEEE Antennas and Propagation Society International Symposium.
[9] AlShehhi, Hamad, Mariam Alzarouni, Noura AlYammahi, Raed Shubair, and Nazar Ali. Compact Low-Profile Wearable Antennas For Breast Cancer Detection. arXiv preprint arXiv:1809.07475 (2018).
[10] Singh, Indrasen, Vijay Shanker Tripathi, and Sudarshan Tiwari. Microstrip patch antenna for breast Cancer tumour detection: a survey. International Journal of Signal and Imaging Systems Engineering 8.4(2015).
[11] Chauhan P, Dey S, Dhar S, Rathod JM. Early Breast Cancer Detection Using Flexible Microstrip Antenna. Kalpa Publications in Engineering.2017Aug5;1:348-53.