iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** V **Month of publication:** May 2021

DOI: https://doi.org/10.22214/ijraset.2021.34031

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

Brain Tumor Detection using Wideband Antenna

M. Arun[1], D. Kalaiarasi[1], S. Anishka[2], K. Preethi[3], P. M. Preeti[4]
[1]Assistant Professor, [2, 3, 4]UG Scholar ECE, Panimalar institute of technology, Chennai.

***Abstract:** A microstrip antenna, commonly known as patch antenna is widely used in mobile communication as it can be easily fabricated and is also well known for its advantages such as low profile and low cost. It also extends its application to RFID (radio frequency identification) fields and healthcare. The proposed system makes use of the patch antenna in the healthcare domain. A slotted microstrip patch antenna is designed by using CST software with a return loss of -37db and VSWR (Voltage Standing wave ratio) value 1.7 to detect tumour inside the brain. The designed antenna is placed in the head phantom with and without tumor model and the difference in parameters such as S-parameter and SAR (Specific Absorption Rate) is analysed. The result is obtained by examining and comparing the above two parameters. By this analysis, we can state whether the person has a brain tumor or not. The antenna works under the frequency band of 2.5– 2.9 GHz. This system can be used to monitor the patient at a remote distance.*
***Keywords:** Microstrip patch antenna, Slotted Antenna, SAR, Return Loss, CST.*

I. INTRODUCTION

A recent survey of 2020 states that around 5-10 cases per 1 Lakh population are affected by a brain tumor. A brain tumor is the growth of abnormal cells in the brain. Brain tumor can be either cancerous or non-cancerous [1]-[5]. Growth of a brain tumor can be varied significantly and the location of a brain tumor, determines how it will affect the nervous system. Treatment options for brain tumor depends on the type of brain, as well as its size and location. The most general way to detect the brain tumor is by x-ray, ultrasound, computed tomography (CT) scan, magnetic resonance imaging (MRI) scan[6]. People exposed to any ionizing radiation have an increased risk of brain tumor[7]. Most people prone to pre-mature death due to the detection of a brain tumor in the final or intermediate stage. Early detection of brain tumor can save lives and prevent death. As microwave imaging technology involves non-ionizing radiation, the possibility of detecting the brain cancer is increased recently and it is safe. In this paper, we present the most accurate, cost-effective, and time-consuming method to detect the tumor in the early stages. The principle used in this project depends upon the dielectric difference between healthy tissue and the tumor. A slotted microstrip patch antenna is considered for brain tumor detection. The antenna is placed and tested using a phantom head model[8]-[11]. A patch antenna is used to transmit Electromagnetic signals and receive the reflected signal from the head phantom model. The proposed system can further provide a detailed analysis of the tumor including exact position and size if multiple antennas are connected and placed in the head.

This paper is organized as follows: Section II Antenna Design, the detailed view of slotted microstrip patch antenna with the parameters and its dimensions are discussed. Simulation results obtained with brain models generated by the CST Microwave Studio are presented in Section III. Finally, discussion and conclusions are provided in Section IV.

II. ANTENNA DESIGN

The proposed antenna is designed by cutting single patch to make it a patch antenna. Cutting of patches in antenna increases the current path which increases the current intensity, as a result efficiency is increased. The basic structure of antenna consists of ground plane, substrate, patch and feed line[13]. The transmission line is the preferred method of analysis for calculating the various dimensions of the microstrip patch antenna[14]. The substrate for the whole antenna structure is air. So, the structure over the plain copper ground plane is entirely supported by the coaxial probe and the shorting pin[15],[16]. The three essential parameters for the design of a slotted microstrip patch are Frequency of operation, Dielectric constant of the substrate and the dimensions of the patch.

Frequency of operation = 2.7 GHz.

Dielectric constant of the substrate = 2.2

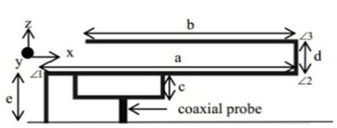


Fig. 2.1 Geometry of Proposed Antenna (Side View)

Figure 2.1 shows the proposed antenna which indicates the radiator fed with microstrip feed line. The radiator consists of slot along with the feed in the radiating edge. These slot with the feed reduces the return loss to a greater extent

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

The dimensions of the geometry:

a	25 mm
b	8 mm
c	3 mm
d	4.5 mm
e	6 mm

Table 2.1 Dimension of proposed antenna

Table 2.1 represents the dimensions of the geometrical antenna and the units are mentioned in mm. Below fig 2.2 represents the final constructed slotted microstrip patch antenna.

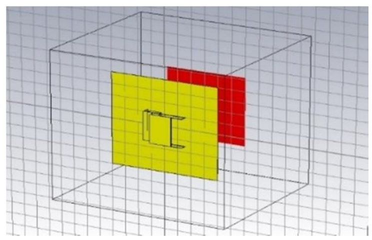


Fig. 2.2 Microstrip Patch Antenna (Front View)

Figure 2.2 shows the designed microstrip antenna using CST software.
The return loss can be calculated using the formula,

$$RL= 10 \log (Pout / Pin)$$

A. Antenna Results

Loss of signal power resulting from the reflection cost at a discontinuity in a transmission line or optical fibre is called return loss

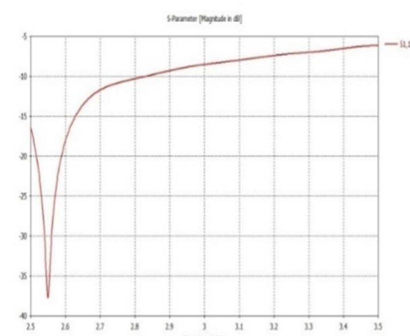


Fig. 2.3 RETURN LOSS at 2.7 GHz

Figure 2.3 shows the proposed microstrip patch antenna with slot using microstrip feed line as a feeding technique, which gives the return loss or reflection coefficient value as -37dB in the frequency range of 2.7 GHz.

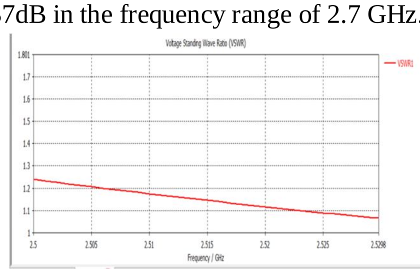


FIG 2.4 VSWR at 2.7 GHz

Figure 2.4 shows that the desirable VSWR (<2) is achieved in the frequency range 0 to 10 GHz. In this design the obtained vswr value is 1.7 for 2.7 GHz frequency.

The transmission feed used in the design to have a frequency range of 2.7 GHz is selected and frequency points are selected over this range to obtain accurate results. VSWR can be measured and examined by installing and tuning the transmitting antenna. The impedance of an antenna and feed line must match exactly for maximum energy transfer from the feed line to the antenna, when a transmitter is connected to an antenna by a feed line.

The radiation field of the microstrip patch antenna is shown in figure 2.5 which is determined using either electric current model or magnetic current model. In the electric current model, the current is used directly to find the far field radiation pattern. If the substrate is assumed to be infinite, the reciprocity method may be used to determine the far-field pattern.

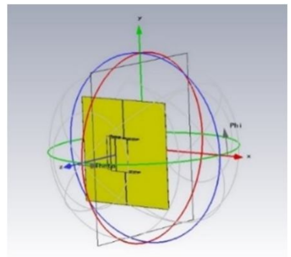


Fig. 2.5 3D Radiation Pattern

Figure 2.5 shows the 3D radiation pattern of the antenna at 2.7 GHz frequency.

III. SIMULATION RESULTS

For simulating the calculated data, computer simulation technology (CST) is used. Antenna parameters such as return loss, vswr, directivity, far-field can be simulated using software [12]. It is a commercial finite element method solver for electromagnetic structures. It can be used for design of complex RF electronic circuit elements including filters, transmission lines and for antenna design.

By varying the widths of the slot, length of the slot, feed and feed positions, S-parameter variation is studied for the slotted patch antenna. This antenna design can be used for multiband applications. The resonant frequency selected for this project is 2.7 GHz and the dielectric material used in this design is air, To increase the bandwidth of the antenna, a substrate with low dielectric constant of 1.00059 is selected.

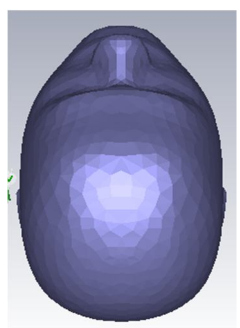


FIG. 3.1: Head without Tumor

Using computer simulation technology studio, the head phantom is imported. Figure 3.1 shows the head without tumor and figure 3.2 shows the head with tumor.

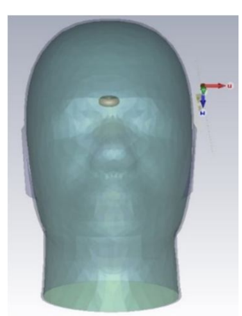


Fig. 3.2: Head with Tumor

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

IV. COMPARISON STUDY

Various parameters of the proposed antenna are observed by the spectrum analyser. The electric and magnetic current models yield exactly the same results for the far-field pattern, provided the pattern of each current is calculated in the presence of the substrate at the resonant frequency of the patch cavity model.

Parameters	With Tumor	Without Tumor
Return loss	-70dB	-30dB
SAR	5.57132e-05 W/kg	1.8171e-0.5 W/kg.
E-Field	72.0384 V/M	22.3849 V/M
H-Field	0.175234 A/M	0.040140 A/M

Table 3.1 Simulated values

Hence the E-Field, H-Field, Specific Absorption Rate, return loss values have been simulated using CST software and the values have been mentioned in the Table 3.1 as simulated values. The resultant values give a clear idea to identify whether the tumor is present in brain or not.

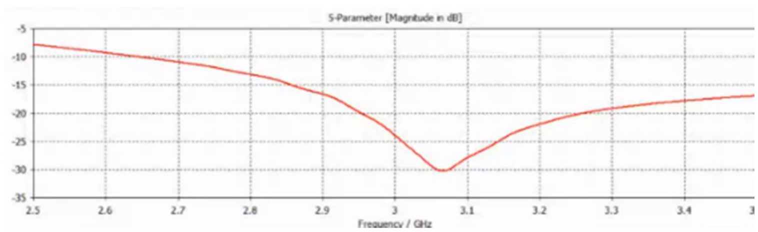


Fig. 3.3 Return Loss at 2.7GHz - Without Tumor

Figure 3.3 shows that the desirable return loss for head without tumor. In this design the obtained return loss value is -30 dB for 2.7 GHz frequency.

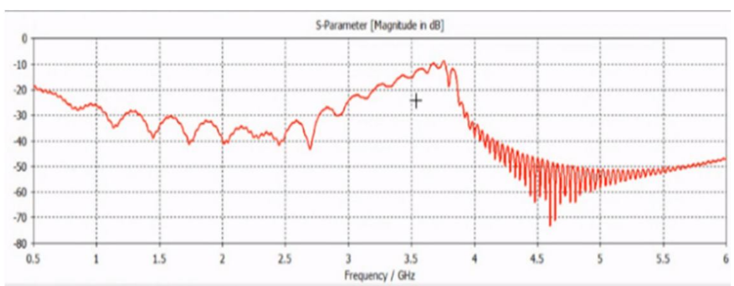


Fig. 3.4 Return Loss at 2.7GHz – With Tumor

Figure 3.4 shows that the desirable return loss for head with tumor. In this design the obtained return loss value is -70 dB for 2.7 GHz frequency. This shows that the return loss has been increased than that of the brain having no tumor.

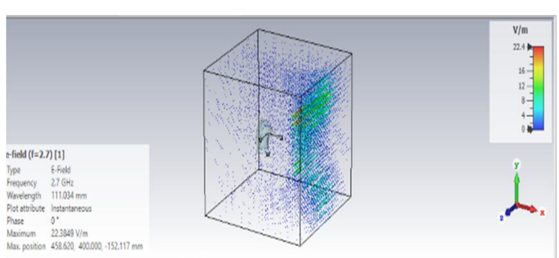


Fig. 3.5 E-Field for Head without Tumor at 2.7GHz

Figure 3.5 shows that the desirable E-Field for head without tumor. In this design the obtained value is 22.3849 V/M for 2.7 GHz frequency.

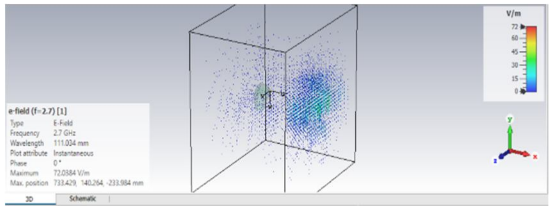


Fig. 3.6 E-Field for Head with Tumor at 2.7GHz

Figure 3.6 shows that the desirable E-Field for head with tumor. In this design the obtained value is 72.0384 V/M for 2.7 GHz frequency. This shows that the E-Field has been increased drastically than that of the brain having no tumor.

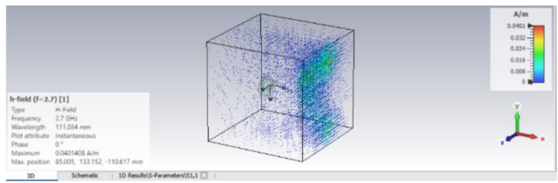


Fig. 3.8 H-Field for Head without Tumor at 2.7GHz

Figure 3.8 shows that the desirable H-Field for head without tumor. In this design the obtained value is 0.040140 A/M for 2.7 GHz frequency

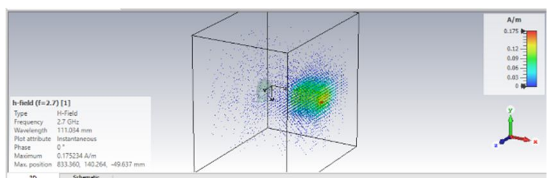


Fig. 3.7 H-Field for Head with Tumor at 2.7GHz

Figure 3.7 shows that the desirable H-Field for head with tumor. In this design the obtained value is 0.175234 A/M for 2.7 GHz frequency. This shows that the H-Field has been slightly increased than that of the brain without tumor.

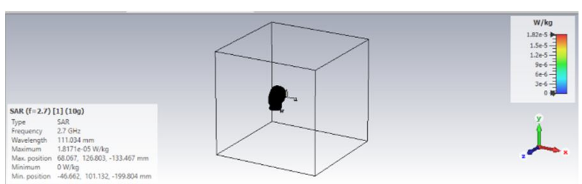


Fig. 3.10 SAR value for Head without Tumor at 2.7GHz

Figure 3.10 shows that the desirable SAR for head with tumor. In this design the obtained value is 1.8171e-0.5 W/kg for 2.7 GHz frequency.

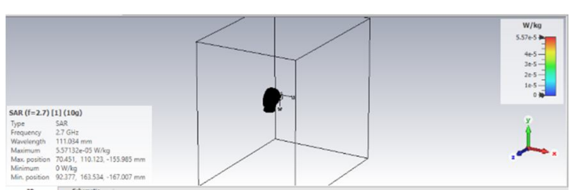


Fig. 3.9 SAR value for Head with Tumor at 2.7GHz

Figure 3.9 shows that the desirable SAR for head with tumor. In this design the obtained value is 5.57132e-05 W/kg for 2.7 GHz frequency. This implies that the specific absorption rate is drastically increased when the antenna is simulated upon brain phantom with tumor.

V. CONCLUSION

This research paper focuses on detecting brain tumor cells present in the head using wide band antenna within frequency ranging from 2.5 GHz to 2.9 GHz. Antenna design parameters such as return loss, vswr, directivity, far-field are also analysed by using rectangular patch slotted antenna. To achieve resonance at lower frequency, a parallel structure is attached with the feeding structure of the antenna. The 3-D model imported in CST software generates more accurate detection of tumor cells. The proposed antenna exhibits five bands, it supports for 2.55 GHz and also has good radiation properties. Therefore, this antenna is suitable for super high frequency applications and other bio medical applications that work in these frequencies.

REFERENCES

[1] I.Rexiline Sheeba, T.Jayanthy "Mobile Application SAR Analysis in Human head model using a Dual frequency triple slotted patch, inset feed, flexible soft wear antenna" International Journal of Engineering & Technology,Vol07,PP:704710.

[2] B. J. Mohammed, A. M. Abbosh, S. Mustafa, and D. Ireland, "Microwave system for head imaging," Instrumentation and Measurement, IEEE Transactions on, vol. 63, pp. 117-123, 2014.

[3] L.Magthelin Therase,Dr.T.Jayanthy "Metamterial loaded circular ring microstrip antenna with CSRR as ground plane for 5G applications" International Journal of Engineering &Technology,Vol 07, Issue 04, PP: 3978-3983, 2018 ISBN No:2227-524X.

[4] Sabouni and A. Kishk, "Dual-polarized, broadside, thin dielectric resonator antenna for microwave imaging," Antennas and Wireless Propagation Letters, IEEE, vol. 12, pp. 380-383, 2013.

[5] T. Mobashsher, A. M. Abbosh, and Y. Wang, "Microwave system to detect traumatic brain injuries using compact unidirectional antenna and wideband transceiver with verification on realistic head phantom," Microwave Theory and Techniques, IEEE Transactions on, vol. 62, pp. 1826-1836, 2014.

[6] X. Li, M. Jalilvand, Y. L. Sit, and T. Zwick, "A compact double-layer on body matched bowtie antenna for medical diagnosis," Antennas and Propagation, IEEE Transactions on, vol. 62, pp. 1808-1816, 2014.

[7] T. Mobashsher and A. Abbosh, "Slot-loaded folded dipole antenna with wideband and unidirectional performance for L-band applications," Antennas and Wireless Propagation Letters, IEEE, vol. 13, pp. 798-801, 2014.

[8] A. Chiu, H. Wong, and C. Chan, "Study of small wideband folded-patch feed antennas," IET Microwaves, Antennas & Propagation, vol. 1, pp. 501-505,2007.

[9] T. Taga and K. Tsunekawa, "Performance Analysis of a Built-In Planar Inverted F Antenna for 800 MHz Band Portable Radio Units," IEEE Journal on Selected Areas in Communications, vol. 5, pp. 921-929, 1987.

[10] W.-L. Chen, G.-M. Wang, and C.-X. Zhang, "Bandwidth enhancement of a microstrip-line-fed printed wide-slot antenna with a fractal-shaped slot, "Antennas and Propagation, IEEE Transactions on, vol. 57, pp. 2176-2179,2009.

[11] S. Ahdi Rezaeieh, A. Abbosh, and Y. Wang, "Wideband unidirectional antenna of folded structure in microwave system for early detection of congestive heart failure," Antennas and Propagation, IEEE Transactions on, vol. 62, pp. 5375-5381, 2014.

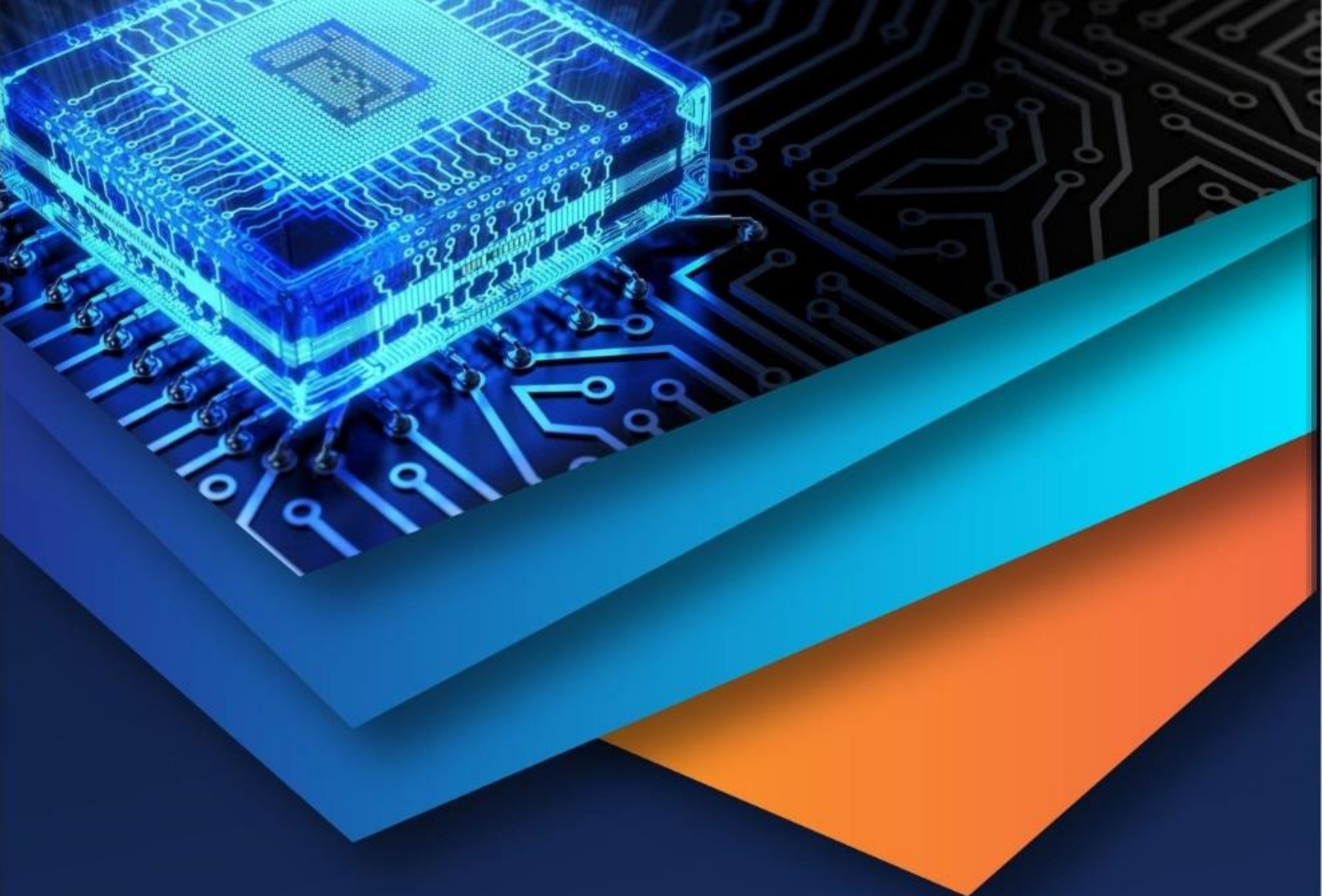
[12] S. Ahdi Rezaeieh, A. Zamani, and A. Abbosh, "3-D Wideband Antenna for Head-Imaging System with Performance Verification in Brain Tumor Detection," IEEE Antennas and Wireless Propagation Letters, vol. 14, pp. 910-914, 2015.

[13] K. Foster, J. Schepps, R. Stoy, and H. P. Schwan, "Dielectric properties of brain tissue between 0.01 and 10 GHz," Physics in medicine and biology, vol. 24, p. 1177, 1979.

[14] S. Gabriel, R. Lau, and C. Gabriel, "The dielectric properties of biological tissues: II. Measurements in the frequency range 10 Hz to 20 GHz," Physics in medicine and biology, vol. 41, p. 2251, 1996.

[15] M. Jalilvand, X. Li, L. Zwirello, and T. Zwick, "Ultra-wideband compact near-field imaging system for breast cancer.

[16] I.Rexiline Sheeba, T.Jayanthy “Design and implementation of flexible wearable antenna on thyroid gland in the detection of cancer cells” Biomedical Research,Vol 29, Issue 11, PP:2307-2312,April 2018 ISSN: 0970-938X (P) |0976-1683(O).



10.22214/IJRASET

INDEX COPERNICUS
45.98

ISRA JIF
IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

ISI

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY