ISSN No:-2456-2165

Detection of Brain Stroke and Brain Tumour Using UWB Pentagon Antenna

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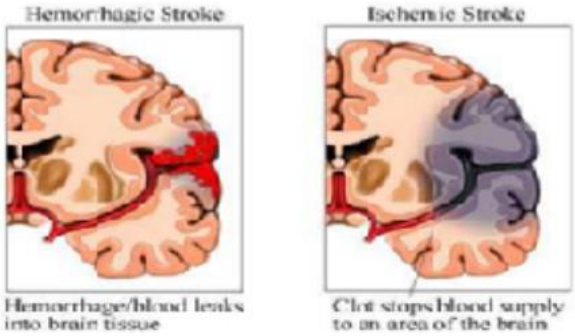
Abstract:-Worldwide, stroke is the leading cause of adult disability, the brain stroke is the third cause of death, ranking only behind heart disease and cancers. Stroke occurs when the blood supply in a part of brain is disturbed as a blood vessel bursts or is blocked by a clot. Delayed or wrong medical analysis can be fatal for the stroke affected patient. It also causes serious long-term disabilities which lead significant economic impact. Therefore, the real-time diagnosis is important, in this paper a UWB Pentagon antenna is designed to detect brain stroke and brain tumor. The use of UWB (Ultra-Wide Band) in stroke detection opens the possibility to develop low cost, fast response and transportable diagnostic devices, which could play a key role in emergency scenarios. It is operating at a band from 3.3568-12.604 GHz in free space and from 3.818 to 9.16 GHz on the normal head model. The antenna has dimensions of 44x30mm^2. It is fabricated on FR4-substrate with relative permittivity 4.4 and thickness 1.5mm. The antenna is simulated on the HFSS software and measured using the network analyzer. There is a good agreement between the measured and simulated results of the return loss of the antenna on human's head and head phantom.

Keywords:-UWB Pentagon antenna, Brain Stroke, Brain Tumor, High Frequency Structure Stimulator (HFSS).

I. INTRODUCTION

The brain is a most important part of Central Nervous System (CNS) which locates inside the skull. Under normal condition, brain uses glucose to supply its energy requirements. The brain's glycogen stores are negligible and depend on the continuous blood supply of oxygen and glucose. In fact, the decreasing of blood supply results most common problem of damage in the brain region. When lack of nutrition and oxygen occurred and neurons in the region confront lack of blood supply for even a few minutes, they stop functioning and die. This neuronal death results from vascular disease calls stroke. Since stroke treatment is depends on the type, the source of stroke and the location of injury stroke diagnosis in progress is critical. The stroke and Transient Ischemic Attack (TIA) have similar symptoms with other general medical conditions such as seizures, fainting and migraine and heart problems. Therefore, it is important to not diagnose as stroke. The stroke treatments are different according to type and play important role in medical diagnosis. Ischemic stroke,



caused by blocked artery in brain and it may be treated with a clot-busting drug called TPA (Tissue Plasminogen activator). If medical doctor diagnose ischemic stroke, it is important to receive drug treatment TPA within 4.5 hours of the onset symptoms. TPA cannot be given if more than three hours passes. The hemorrhagic stroke is result of a ruptured blood vessel or a week area of blood vessel that bulges.

II. ANTENNA DESIGN

An UWB pentagon antenna is implemented on FR4-substrate with relative permittivity 4.4, electric conductivity 0.025S/m and thickness1.5 mm. It has dimensions 44x 30mm2 as shown in figure . The antenna is feeded through a 50 ohm matched micro strip line. Table I lists the dimensions of the antenna. It has an omni directional radiation pattern. The antenna can be obtained with different strategies, edges and curves. It has a truncated ground such that other modes can beon setting and it can contribute with other frequencies.

ISSN No:-2456-2165

Dimensions	Length in mm
L1	44
L2	30
L3	23
L4	20
L5	8.58
L6	7.8

Table 1: Antenna Dimensions

III. SIMULATION & MEASUREMENTS

The pentagon antenna is measured and simulated in free space as depicted in figure 2. It is also simulated on a rectangular head model consists of 3 layers, skin, skull and brain. The electrical properties of the head model are depicted in table II. Figure 3 shows the structure of the simulated phantom model and its dimensions are presented in table III. The antenna is measured on a real human's head as shown in figure 4.Figure 5 depicts the depicts the measured return loss of the antenna on real human head and the simulated one on normal head model [6].

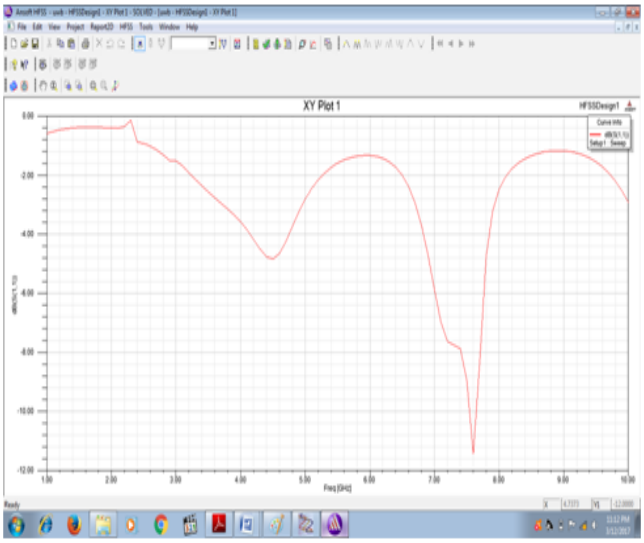


Fig 2:- Return loss of the Antenna in Free Space

	Electric Permittivity	Electric Conductivity
Brain	49.7	0.59
Skull	17.8	0.16
Skin	46.7	0.69

Table 2. Electrical Properties of Human Head Model

Dimensions	Length in mm
X1	90
X2	90
X3	79
X4	72

Table 3 Dimension of the head model

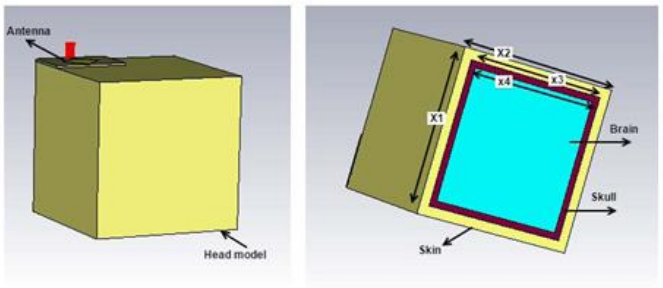


Fig 3:- Structure of Human Head Model

Fig 4: Measurement of the antenna on human's head using network analyzer.

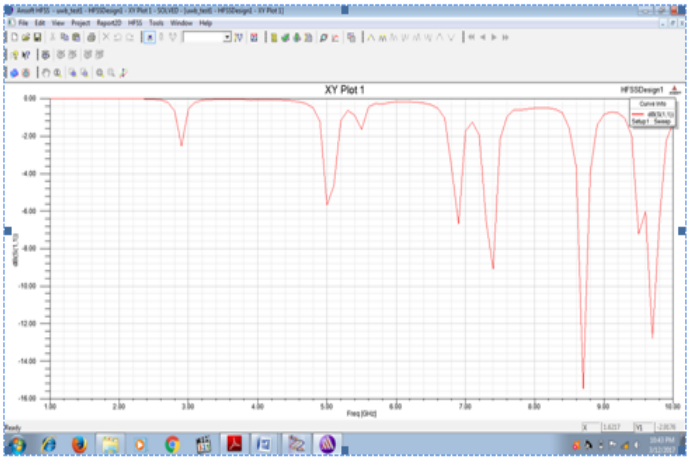


Fig 5: Return loss of the antenna on human head.

IV.EFFECT OF TUMOUR ON THE ANTENNA PERFORMANCE

The antenna is investigated on human's head model with a spherical shaped tumor of radius 24.6, electric permittivity 70 and loss tangent 0.23 as stated in [7, 8] and shown in figure 6. The return loss of the antenna with tumor is shown in figure 5.

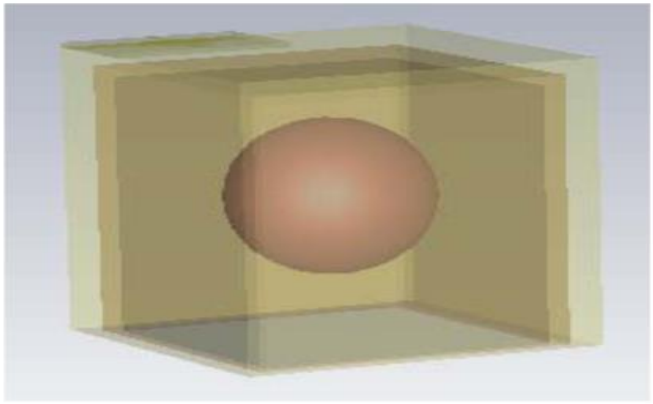


Fig 6:- Antenna o human model with tumor

V. CONCLUSION

The project delineates the plan and usage of a pentagon receiving wire for mind growth and stroke location, situated straightforwardly on human's head. It is reproduced utilizing HFSS microwave studio and created on FR-4 substrate with relative permittivity 4.4 and thickness 1.5mm. It is called attention to that there is a recurrence move of frequency shift between the ordinary head show and the one recreated with tumor and stroke when re-enacted on head model. The pentagon receiving wire is additionally measured on a normal head apparition. The various parameters are measured for the proposed structure and the design is fabricated on FR-4 substrate.

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