DESIGN AND ANALYSIS OF WEARABLE ANTENNA FOR WIRELESS NETWORK COMMUNICATION USING FEKO

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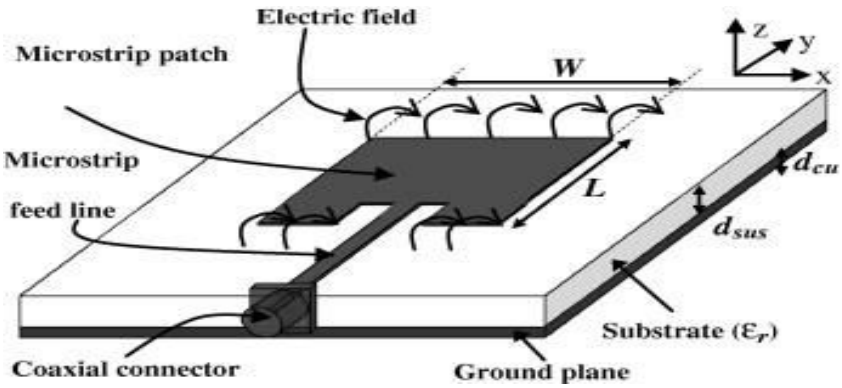
Abstract- The fast development of wearable low-electricity devices has multiplied the requirement of answers for WBAN implementation. In addition to the need, to reduce the device's dimensions and improve power consumption, it is also crucial to work on growing bendy antennas that can be integrated right into a wide kind of applications. This paper has a look at of wearable antenna layout for wireless body vicinity community applications. A literature overview of existing wearable antennas is studied. A wearable antenna is designed with size optimization. The antenna is designed for the usage of FEKO software tool. The designed antenna works at a working frequency of 2.45 GHz. A rectangular patch made of copper is used as a radiating patch and the floor is likewise made with copper. The substrate material used is bed sheet cotton with a relative permittivity of 3.27 and the loss tangent is 0.00786. The size of the antenna is 40mm*34mm*1.26mm. The properties such as advantage directivity and VSWR are studied for the designed antenna. The residences have studied the usage of the FEKO software program.

Keywords – wearable, relative permittivity, VSWR, radiating patch.

I. INTRODUCTION

Portable electronic gadgets have ended up the main part of normal human life. Mobile phones which we carry during the day not best permit us to just make smartphone calls however also provide net access, multimedia, personal virtual assistant and GPS capability. This form of non-stop connection allows an ahead step in the pc paradigm. In the approaching generations, human beings are probable to carry a variety of gadgets and sensors, together with clinical sensors that constantly talk with each other and the outdoor international and these are exceptionally clean to carry. It is of predominant significance to provide this capability as the technology is upgrading every day. A key generation to attain this intention is wearable electronics and antennas. Microstrip patch is well acceptable for any wearable application, as it can be made conformal for integration into clothing. A wearable antenna is mainly used for biomedical applications. Body centric conversation structures like paramedics, hearth fighters, and army programs are used by one-of-a-kind specialized career segments. The wearable antennas can be carried out to all forms of aged people and for athletes for the cause of monitoring. Wearable antennas should contain the subsequent residences they need to be mild in weight, exceptionally low cost, nearly maintenance-loose and without installation. They should be comfortable and conformal to the body shape, however, they ought to be tremendously dependable and efficient. There are many problems with the packages of Wearable antenna. The most important issues are they must be included onto a garment and boom the consolation of wearable, the antenna ought to be of minimal size. Furthermore, it is difficult to preserve the antenna flat and operating while the humans move, so the antenna below unique bending and crumpling conditions has been studied. Finally, they have an impact on of human frame to the antenna that must be taken into consideration as well. Now on this paper, we will study about the layout of a wearable antenna with the aid of optimizing its size. And we will have a look at the analysis of the antenna with one kind of parameter. In this, we also have a look at approximately the interaction between a wearable antenna and human frame and the evaluation.



II. LITERATURE SURVEY

2.1 SURVEY ON WEARABLE ANTENNA DESIGN:

A planar inverted-F antenna is designed to perform on WBAN its miles preferred because of its low profile and Omnidirectional properties. The patch and the floor layer carry out a more crucial task of isolating and decoupling the wearable antenna from the human body. The patch size of the antenna is extended to reduce the go back loss and to improve efficiency even the SAR value is reduced whilst the patch size increases. Polydimethylsiloxane (PDMS) as the. The design is done using CADFEKO and the results also are proven with equal software. A compact planar dipole antenna is built using fully bendy substances along with nitrile butadiene rubber polymer composition is used as substrate. The patch is made from copper. The performance of the antenna is analysed by using 3 layers of human tissue. UWB wearable textile antenna for body location networks with a Hexagonal patch with a partial floor plane is proposed. The ultra-extensive bandwidth proposed may be received through decreasing its size, and by introducing a rectangular notch inside the ground and a singular slot inside the patch. Dacron cloth with a relative permittivity of 3 is used as a substrate. Commercial electromagnetic simulation package CST Microwave Studio is used for the layout and simulation of the antenna.

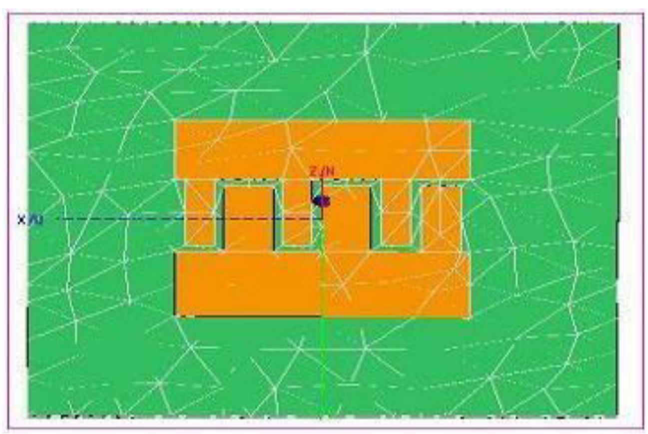


Figure 1. Microstrip rectangular patch antenna

2.2. INTERACTION BETWEEN WEARABLE ANTENNA AND HUMAN BODY:

Wearable antennas are awfully close to the human body. The proximity of the human body with an antenna with a high dielectric steady and loss are regarded to have a few detrimental effects on entering impedance and performance of the antenna. The body affects several the major residences of the antenna just like the mismatch which is brought about by feature impedance of transmission lines, electrical length changes, and constantly growing losses, for this reason, detrimental its original operation. The interaction between the frame and the wearable antenna may be studied underneath two Categories.

2.3. EFFECTS OF ANTENNA ON HUMAN BODY:

The non-ionizing radiations just like the sound waves, visible mild and microwave will not have enough electricity to ionize atoms or molecules however this electricity is enough to move atoms or maybe to lead them to vibrate. Non-ionizing radiation can circulate human cells and increase cellular temperature. This rise in temperature affects the human tissues, the most not unusual of this kind is dielectric heating. This happens when a dielectric cloth is heated by way of rotations of polar molecules brought on via the electromagnetic subject. Specific Absorption Rate (SAR) is the parameter that is used to degree the charge at which energy is absorbed with the aid of human tissues. It can also be defined as the price at which RF electromagnetic energy is imparted to unit mass of the biological body. SAR is typically measured average both over the complete body, or over a small patch pattern volume commonly 1 g or 10 g of tissue. The fee thus obtained is the maximum stage measured in the frame element studied over the stated volume or mass. The system used to calculate SAR is given as SAR=!"/# Where, stands for electric conductivity, E stands for RMS electric subject and # stands for pattern density. There are certain rules and rules to be followed within the world regarding the SAR restrict of electromagnetic gadgets due to the fact the high SAR values may additionally have intense results on the human body. The SAR restriction is set to 1.6 W/kg averaged over 1 g of actual tissue via the Federal Communication Commission (FCC), at the same time as the limit is set to 2 W/kg averaged over 10 g of real tissue through the Council of European Union. The restriction of temperature growth in head tissues is 1 K. This increase in the temperature in the head tissue can also influence the behaviour, functioning, and memory of the people besides inflicting anatomical injuries.

2.4. EFFECTS OF HUMAN BODY ON WEARABLE ANTENNA:

The human frame also has some outcomes on the antenna because it very closely placed on the human body. The human body is lossy and disturbs the communique link between the antenna and the outdoor world. The human body's impact on the antenna is of various types.

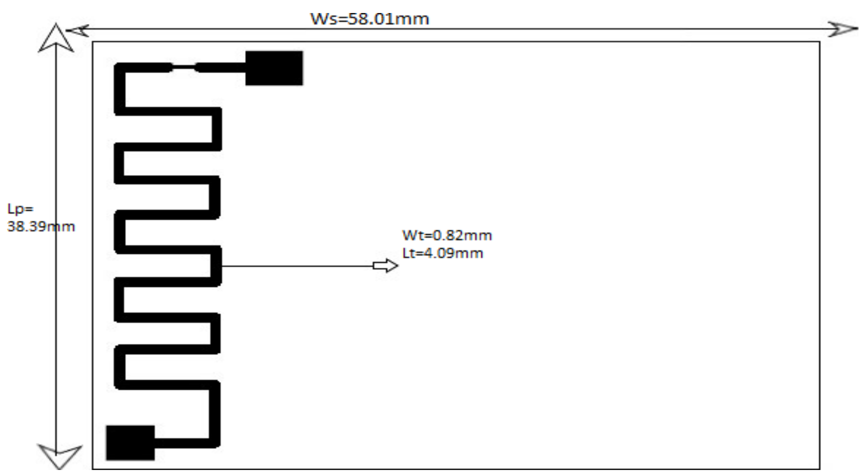


Figure2 wearable antenna design model

2.5. HUMAN BODY INDUCED GAIN:

The human frame induced gain is the ratio of gains (in dB) between the body-worn antenna and that of the antenna in unfastened space. The human frame has numerous tissues with numerous dielectric residences. Also, the electrical residences on distinctive frequencies have special values, the advantage of the antenna is affected. So, the benefit of the wearable antenna differs from that of an everyday antenna.

2.6. HUMAN BODY WORN EFFICIENCY:

The human frame-worn efficiency is the ratio of total radiated electricity whilst the antenna is worn in the frame to the entire radiated power in free space isolation. The overall energy loss in a human body can be represented through this. Human Body Effect on Impedance The enter impedance of the antenna can be low when the user is too near the antenna. Also, the enter impedance is depending on the moisture conditions of the human body. And the position of the antenna.

III. ANALYSIS REQUIRED FOR WEARABLE

Generally, the measurements required for normal antenna layout go back loss, radiation pattern, benefit, and efficiency. However, these planar antennas always stay flat, so it is not always important to degree its bending characteristic. But we have to degree the bending traits of a wearable antenna and some other elements need to be taken into careful attention to assure the overall performance of the antenna in a body-worn context. They are as follows

3.1. SAR MODELING:

As the wearable antennas are attached awfully close to the human body the SAR model values must be taken into serious consideration because they will influence the human body. The SAR and its effective values to be maintained are studied in the sooner sections.

3.2. MEASUREMENT WITH DIFFERENT BENDING:

As we are reading about the wearable antenna, we should have a look at the properties of the antenna underneath specific bending conditions. Because the human frame does now not continue to be flat always. We can look at the bending influences by attaching the antenna to a cylinder-like structure or other different things with different shapes. By analyzing all the measurements and if an appropriate end efficient only then we must apply them to the human body in any other case we would get false values. The antenna had to be designed with a wide frequency bandwidth for powerful.

3.3. ON BODY MEASUREMENTS:

Besides stand-by myself antenna measurements, wherein the antenna becomes measured without the presence of the human body, on body measurements should be finished as well, to be able to confirm the performance of the antenna at one of a kind on-frame position. Positions of wearable antennas will differ, relying on the software of the antenna. Wearable antennas might be designed to be placed at the chest, arm, returned of the frame, etc. From these preceding investigations, it changed into determined out that the antenna located at the lower back of the frame is the maximum stable area that will lessen the exchange of body orientation compared to other parts including the arm.

IV.PROPOSED METHOD

The main drawback of the prevailing system is that they contain narrow bands and enormous in size. The proposed antenna overcome these drawbacks of the prevailing system. the size of the antenna is 40*34*1.26mm which is compact in size.

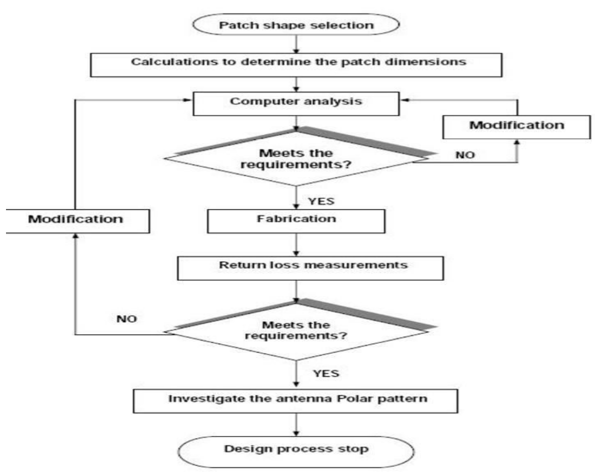


FIG 3

V. RESULTS AND DISCUSSION

GAIN: It relates the intensity of an antenna in a given direction to the intensity that radiates equally in all direction to the intensity that radiates equally in all directions or isotropic ally has no losses. Since radiation intensity from a lossless isotropic antenna equals the power into the antenna divided by a solid angle of 4pi. Hence the following equation can be written as

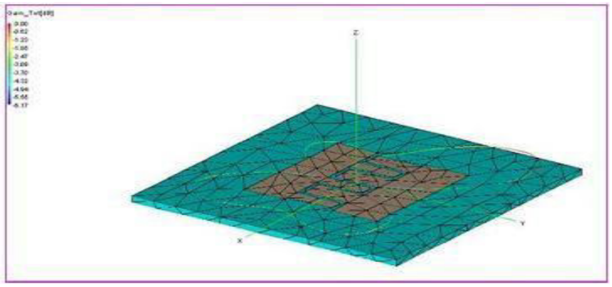


Fig 4 Gain with wash cotton substrate

RETURN LOSS: The antenna performance greatly depends on return loss. If the return loss increases the antenna performance also increases from the results wash cotton has greater return loss.

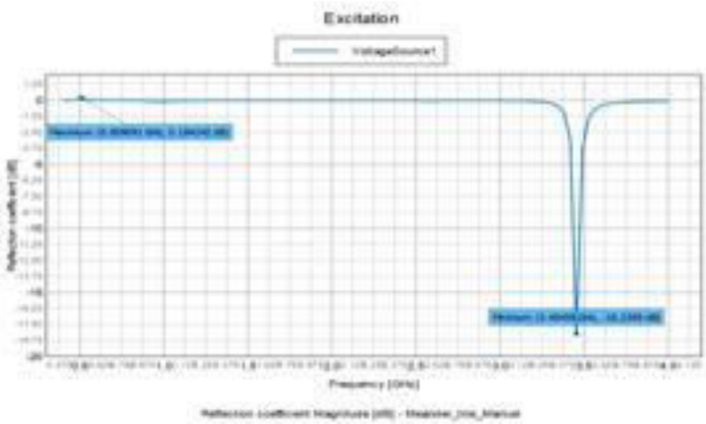


Fig 5. Return loss of reflection coefficient

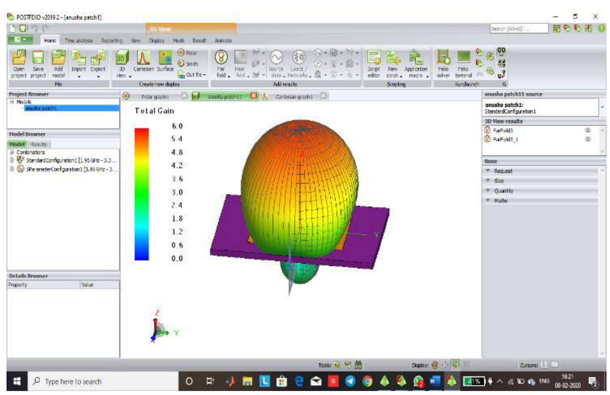


Fig 6. 3D view of wearable antenna in POSTFEKO

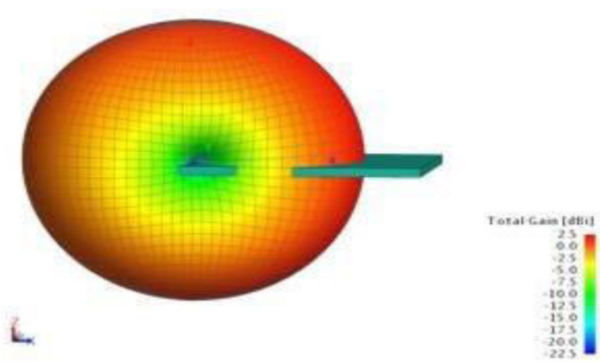


Fig 7. 3D view in single direction

VI. CONCLUSION

The design of a wearable antenna for wireless body area network applications is studied during this paper. The designed antenna is compact in size compared to the previously designed antennas. The designed antenna has given a good end in all the properties. because the antenna size is 40*34*1.26mm this will be fitted to wearable applications. Also, the designed antenna acts as a multiband antenna and its wide selection of operating frequency. This antenna provides a wider bandwidth within the frequency range of two .1GHz to 2.7GHz and 3.6 GHz to 4. 3GHz. The antenna has an efficiency of 94%. The SAR value of the designed antenna is 1.25 which is a smaller amount than the SAR limitation, so this antenna won't cause radiation problems when placed on a person's body. So supported all the analyses made the designed antenna are often compatible with wireless body area network applications.

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