RESEARCH PROPOSAL

TITLE:

Design Wearable antenna with metamaterials for biomedical applications

INTRODUCTION:

Communication technologies and biomedical sensors can provide services for the patient's vital signs to be monitored outside the clinical environment. The need for wearable or implantable telecommunication devices for medical applications has been growing rapidly over the past ten years. Microwave antennas and sensors are key components of telemetry systems related to medical applications. Metamaterials are artificial materials which have the electromagnetic properties that may not be found in nature. The unusual properties of a metamaterial have led to the development of metamaterial antennas, sensors and metamaterial lenses for miniature wireless systems which are more efficient than their conventional counterparts. Metamaterials exhibit a very sensitive response to the strain, dielectric media, chemical and biological sensing applications. The design concept of wearable metamaterial antenna in ISM band for biomedical applications is the fundamental theory and recent progress of metamaterial in antenna for various healthcare applications towards its practical implementation. This proposal is to design wearable metamaterial antenna for various biomedical applications.

OVERVIEW:

In Recent years, need for the deployment of wireless telemetry systems in medicine has significantly increased due to necessity for early diagnosis of diseases and continuous monitoring of physiological parameters. Microwave antennas and sensors are key components of these telemetry systems since they provide the communication between the patient and base station. Metamaterials can have their electromagnetic properties altered to something beyond what can be found in nature. Hence metamaterials have been attracted great interest among microwave engineers and physicists, due to showing exotic electromagnetic properties at microwave frequencies. A split-ring resonator (SRR) is one of the metamaterial particles that offer negative permeability, while complementary split-ring resonator (CSRR), the duality of SRR, interacts with the electric field and introduces negative permittivity, which are most commonly used in biomedical sensors. It is well known that SRRs are resonant structures, and consequently, it is possible to employ these resonances as well as radiating modes. SRRs are very compact and it is easy to design them with dual band characteristic. Metamaterials gain their properties not from their composition, but from their exactingly designed structures. These metamaterials achieve desired effects by incorporating structural elements of sub-wavelength sizes, i.e. features that are actually smaller than the wavelength of the waves they affect. Metamaterial antennas are a class of antennas which use metamaterials to increase performance of miniaturized (electrically small) antenna systems. Their purpose, as with any electromagnetic antenna, is to launch energy into free space. However, these incorporate metamaterials, which are materials engineered with novel, often microscopic, structures to produce unusual physical properties. Antenna designs incorporating metamaterials can step-up the radiated power of an antenna. Novel components such as compact resonators and metamaterial loaded waveguides offer the possibility of previously unavailable applications. The metamaterial, on the other hand, makes the antenna behave as if it were much larger than it really is, because the novel antenna structure stores energy, and re-radiates it. Hence, these novel antennas appear to be useful for wireless systems that continue to decrease in size for applications such as portable interaction with satellites, wide angle beam steering, emergency communications devices, micro-sensors and portable ground-penetrating radars to search for tunnels, caverns and other geophysical features. In addition, already established lithography techniques can be used to print metamaterial elements on a PC board.

GENERAL MECHANISM:

One of the major applications is cancer removal by burning tumour. Cancer is the uncontrolled growth of abnormal cells in the body, called as malignant cells. By developing microwave devices and combining it with structures inspired by metamaterials, it can lead to a very cost-effective device that can localize with high precision an abnormality within the human body. The basic principle behind the cancer detection is, a small change in the water content of biological tissues produces changes in the permittivity (ϵ) and conductivity (σ) values of the tissues. The malignant cells have significantly higher water content than normal tissues. Hence the permittivity and the conductivity of the tumor are higher than those ones of a normal tissue at microwave frequencies. The proposed biosensor consists of an array of complementary metallic metamaterial resonators. The reason for choosing SRRs are their strong response to an electromagnetic field.

OBJECTIVE:

The Objective is to design an antenna with perfect hardware for minor and major invasive procedures. The key idea behind the wearable metamaterial antenna is the simultaneous application of biomedical, telemetry, wireless, radar, and satellite etc. This antenna designed with metamaterials for major advancement for lower density, lightweight, small, enhancing, performance, compact and easy to design. This technology can be easily used to kill the cancer tissue by alone or in adjuvant with other measures.

PROBLEM DEFENITION:

Biomedical field requires circuit design which has a broader range of material parameters resulting in negative refractive index has resulted in antennas that are innovative. Combining a left-handed transmission line segments with a conventional (right-handed) transmission line results in novel configurations with advantages over antenna designs for biomedical applications.

SCOPE OF THE PROJECT:

There is growing need for engineers and physicists to concentrate and develop equipment's specifically suitable for healthcare. Metamaterials is one of the active fields of research in the past decade which has potential application in healthcare. This proposal summarizes the extensive use of metamaterials in biomedical applications. In particular, an overview to design the metamaterial antenna to operate at ISM band and the use for wide applications of metamaterials in cancer detection, microwave hyperthermia, strain sensing, reduction of SAR. Apart from these, metamaterials are also applied in glucose monitoring for diabetes management. Also, the use of resorbable metamaterials will overcome the issues associated with retrieval of implantable devices after their operational lifetime. The metamaterials in biomedical applications opens a wide area of research with high compact size, high performance, low density are more applicable.