

ABSTRACT

Body Area Wireless Communication (BAWC) has become an essential part of Health Monitoring (HM) applications. HM is performed on patients, elderly citizens, and physically and mentally challenged people to monitor the health of their bodies and communicate with the doctor or device for analysis of their health conditions. In the proposed work, two such antennas were developed using jeans as the substrate material since BAWC requires wearable or flexible materials to fabricate the antennas. Body Area Networks (BANs) are required for personal communication inside and outside the body. Wearable and textile antennas are used in BAN systems such as patient monitoring, medical equipment, firefighter safety clothing, and so on. Therefore, this work aims to design and develop antennas for biomedical applications with high gain, directivity, compactness, and improved bandwidth. Metamaterials are embedded in antennas due to their negative permittivity and permeability properties. As a result, the proposed system offers a wider bandwidth, high gain, high directivity, and smaller size.

The proposed UWB antenna I is based on the UWB technique with a Complementary Split Ring Resonator (CSRR) based metamaterial antenna. The UWB band is the range that covers frequencies from 3.1 GHz to 10.6 GHz. Due to the high data rate and short-range coverage with high resolution, the UWB technique is adapted to several health monitoring systems. A UWB antenna I is introduced with a partial ground plane, and a rectangular slot. Additionally, a permittivity-based textile material called Jeans is used as a substrate. The dielectric constant of the material is 1.67 for a thickness of 2 mm. CSRR is embedded at the center of the patch, and the patch has bottom corner truncations. The microstrip feeding technique is used. The return loss characteristics and bandwidth values are up to the desired level of -10 dB and 7.5 GHz for BAWC. The antenna obtained the highest return loss value in dB is -50 dB, and bandwidth varies from 2.9 GHz to 11 GHz. Hence, the proposed

CSRR-based textile UWB antenna I is a suitable candidate for the BAWC application according to various parametric studies. A metamaterial CSRR antenna increases UWB bandwidth from 2.9 GHz -11 GHz, while a textile antenna maximizes directivity by 8 dBi, and the overall size of the antenna is 36 mm × 29 mm.

The proposed UWB antenna II is based on the slot technique, and the shape of the slot is hexagonal. Similar to UWB antenna I, UWB antenna II focuses on UWB in BAWC. Since the antenna is used for biomedical applications, similar Jeans textile material is used with a permittivity of 1.67. The thickness of the substrate material is 2 mm. But the frequency coverage value of the antenna is broader than that of the UWB antenna I. In addition, the partial ground plane is used to enhance the bandwidth. The hexagonal-shaped slot induces heavy current density at the center of the antenna, and hence the corners of the radiating element get the maximum current flow. Therefore, it gives the effect of the CSRR present in the antenna. Moreover, the step-shaped truncation at the bottom side of the patch helps to improve the bandwidth in terms of better impedance matching. Thus, the proposed UWB antenna II is also suitable for the BAWC application. Validation is done by comparing the performance characteristics of the proposed antennas with previous work. Jeans material is implemented in the proposed work in the range of 2.9 GHz to 10.9 GHz for wearable health care devices. CST Microwave Studio simulation software was used to simulate the proposed antennas. Compared to conventional antennas, this research work provides a minimum return loss, good VSWR, high impedance, good directivity, and a good gain, enabling maximum signal transmission with no loss. This research work starts with the design, simulation, fabrication, and finally testing of an antenna for a biomedical application.