Conformal Antenna Design for Ingestible Capsule Imaging System

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The development of novel medical tools like ingestible endoscopic imaging capsules and wireless medical implants have garnered immense research interest over the past decade. The success of these ingestible and implantable medical devices depends on the robustness of the communication link, the transmitter receiver design, and power consumption. The ingestible devices incorporate electronics that are capable of storing and recording information of the patient. Some of them use a bidirectional communication link where they transmit information to the receiver and they can also be reprogrammed by an external machine. This requires the presence of an antenna inside the device to transmit and receive signals. One of the main issues is the reliable remote management of these medical devices which helps the clinician obtain valuable diagnostic information in order to monitor the patient's condition. Thus, the design of the antenna in systems like capsule imager becomes a critical issue.

Previously, low-frequency coiled antennas have been used for biotelemetry due to their reliability. But this inductive link was limited by slow data rates and short of communication link between the device and the receiver. FCC allocated new bands at higher frequencies to overcome some of the problems which include 915 MHz industrial, scientific, and medical (ISM) bands, 402–405 MHz medical implant communication service (MICS) band and 1395–1400 MHz wireless medical telemetry services (WMTS) band.

In this paper, a practical antenna design is presented for the wireless capsule endoscopy imaging system at WMTS band. This system can help remotely monitor the patient, obtain real-time biological statistics and can replace the traditional endoscopic procedures. This capsule camera system contains electronics inside the capsule making the design of the antenna a challenging task. The antenna design should take into account miniaturization due to the small size of the capsule, omni-directionality of the radiation pattern, conformality of the capsule pill, the presence of electrical components inside the capsule and the body detuning effects. The antenna design proposed here is based on the planar offset meandered dipole antenna. The antenna is conformed on the inner surface of the capsule and thus utilizes the space effectively. The antenna parameters are easily tunable. Due to the conformal nature, there is polarization diversity. The effects of electrical components and human body on the antenna performance have also been investigated. The measured data for the planar and conformal antennas will be presented.