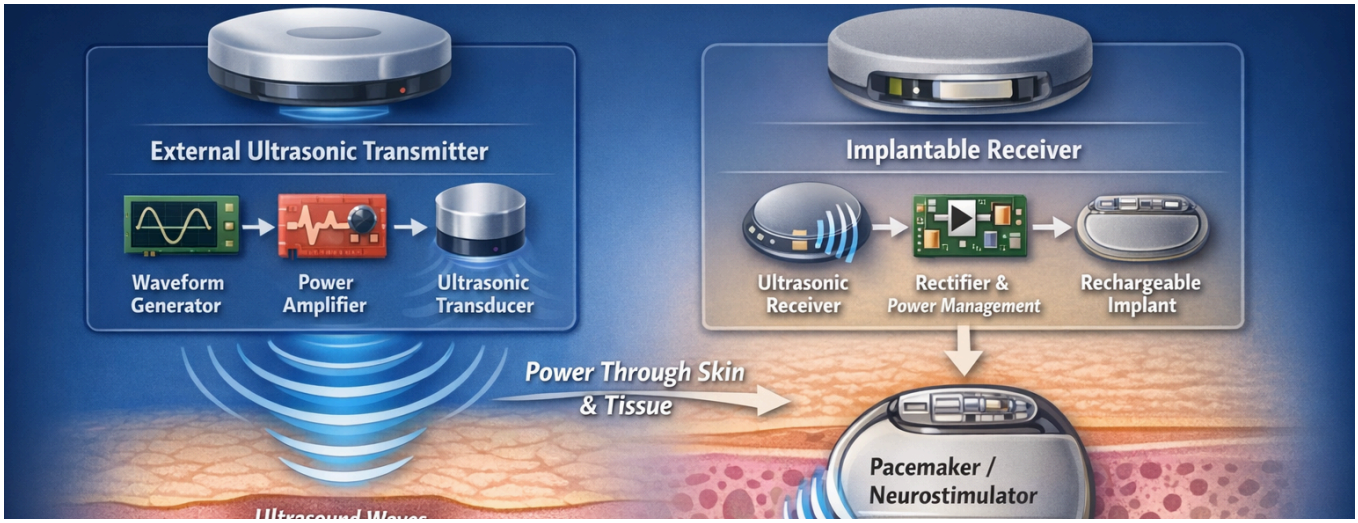
SYSC 4907 M2

Design and Development of a Wireless Ultrasonic Charger for Implantable Medical Devices



AI-generated image illustrating the concept

Group size: 3 or 4 students.

Suitable for: Students with interest in electronics, instrumentation, circuit design, Electrical, Computer Systems, and Software Engineering students. A multidisciplinary team with students from different programs is preferred.

Desired background: Electronics, circuits, ultrasonics, prototyping.

Supervisor: Prof. C. Rossa: carlosrossa@cunet.carleton.ca

Lab information: https://www.biomechatronics.ca

Before joining the project, please form a group of 3 or 4 students and contact Prof. Rossa by email. Approval is required before joining the project.

Project Description: This project focuses on the design, development, and experimental validation of an ultrasonic wireless power transfer system to recharge implantable medical devices, such as pacemakers, neurostimulators, or drug delivery systems. The main goal is to develop a compact external ultrasonic transmitter and a complementary miniaturized receiver capable of delivering power through skin and tissue to recharge low-energy implants efficiently and safely. Unlike traditional electromagnetic wireless charging, which requires large coils, has limited penetration depth, and can interfere with implant electronics, ultrasonic power transfer allows deeper tissue penetration while minimizing electromagnetic exposure. Students will define system specifications, frequency, geometry, and power requirements, design the external power electronics that drive the ultrasonic transducer, including waveform generation and amplification circuits, and develop the receiver-side electronics for rectification, power conditioning, and storage. Students will then fabricate and integrate prototypes of the external transmitter and implantable receiver and measure energy transfer efficiency.

Anticipated Deliverables: A functional ultrasonic wireless power transfer prototype and driver electronics validated in phantom tissue along with detailed technical documentation.