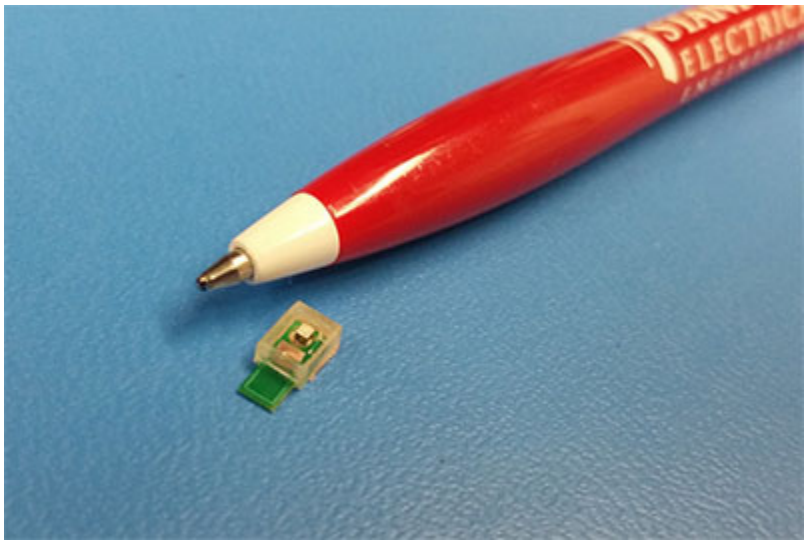
Docket #: S13-173

Wireless, Ultra-Low Power Implantable Device

Stanford researchers have built a sound powered, wireless medical implant. The implant contains a piezoelectric energy receiver, an integrated circuit chip, and a loop antenna. It converts ultrasound to energy, executes medical commands, and relays results all without the need for wires or battery. The device has a higher efficiency, longer range, better performance, and is less invasive than current RF implants of the same frequency. This low-power sensor has a wide range of medical applications from health monitoring to nerve, muscle, or brain stimulation treatments.



Stage of Research
Researchers have built and tested devices with various data links and power levels. Plans for an optogenetic stimulator implant are underway.

Applications

- Low-power sensors with end user applications in:
    - Medical implants such as pacemakers, continuous glucose monitoring, etc.

    - Deep tissue implants
    - Nerve stimulation (muscle or brain)
    - Optogenetic implants that can be programmed wirelessly
    - Brain implants

Advantages

- More energy efficient
- Longer range of operation (e.g. deep tissue implants)
- Less invasive - much smaller than RF implants of same frequency
- 1/10 penetration losses in tissue
- Better energy capture capability for sensor (wavelength and aperture)
- Improved bandwidth and data-rate
- Improved energy recovery for applications that need deep electrical stimulation
- Improved multi-access capability for many-sensor scenarios

Publications

- M. J. Weber, A. Bhat, T. C. Chang, J. Charthad, and A. Arbabian, “A Miniaturized Ultrasonically Powered Programmable Optogenetic Implant Stimulator System,” in IEEE Biomed. Wireless Technol., Networks, Sens. Syst. Top. Conf., Austin, TX, USA, Jan. 2016.
- T. C. Chang, M. Weber, J. Charthad, A. Nikoozadeh, B. T. Khuri-Yakub, and A. Arbabian, "Design of High-Efficiency, Miniaturized Ultrasonic Receivers for Powering Medical Implants with Reconfigurable Power Levels," IEEE IUS, Taipei, Oct. 21-24, 2015.
- J. Charthad, M. J. Weber, T. C. Chang, M. Saadat, and A. Arbabian, "A mm-Sized Implantable Device with Ultrasonic Energy Transfer and RF Data Uplink for High-Power Applications," Custom Integrated Circuits Conference (CICC), 2014 IEEE Proceedings of the, 15-17 Sept. 2014.
- J. Charthad, M.J. Weber, T.C. Chang, and A. Arbabian, "A mm-Sized Implantable Medical Device (IMD) With Ultrasonic Power Transfer and a Hybrid Bi-Directional Data Link," IEEE Journal of Solid-State Circuits, vol. 50, no. 8, Aug. 2015.
- Arbabian, Mohammad Amin, Marcus Weber, and Jayant Charthad. "Hybrid communication system for implantable devices and ultra-low power sensors." U.S. Patent Application No. 14/276,827.

- STANFORD ENGINEERS DEVELOP TINY, SOUND-POWERED CHIP TO SERVE AS MEDICAL DEVICE October 14, 2014.
- Stanford engineers develop tiny, sound-powered chip to serve as medical device Stanford Report, October 15, 2014.

Patents

- Published Application: 20140336474
- Published Application: 20170125892
- Issued: 9,544,068 (USA)
- Issued: 10,014,570 (USA)

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