Flexible Electronics Vitals Sensor

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ECE 445 Spring 2013 – Prof. Paul Carney

Introduction

Purpose

We chose this project because of our interest in cutting edge wireless communication systems, namely BAN's (body area networks) and their recent integration with flexible electronics research here at the University of Illinois. This area of research, if it is successful, could greatly change healthcare and advance the field of bioinformatics.

Objectives

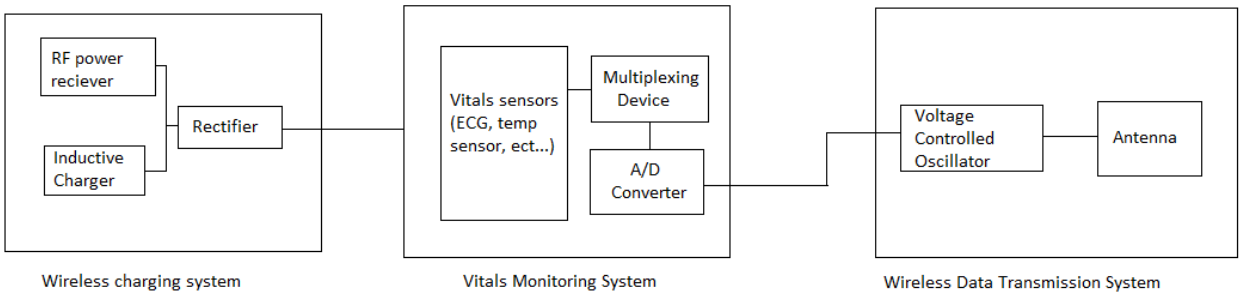
The goal is to create a small flexible electronics transmitter, about the size of an average bandage, which can measure a person's vitals such as ECG (heart rate) and core body temperature. It will transmit this information over the air in real time to a receiver, where it will be displayed in a graph format and stored for later analysis (such as for medical studies). The following is a list of features of the proposed project, along with the perceived benefits of each.

- Wire-free vitals monitor
  - Allows for mobility while still being able to monitor patients
- Small size and flexibility allows for reduction in physical profile
  - Device is less intrusive and more seamlessly integrated into everyday tasks
  - Capable of being used where previous "rigid" devices were unable to operate
- Ability to display near-real time data via wireless transmitter
  - Allows for studies that could not normally be performed with wired devices

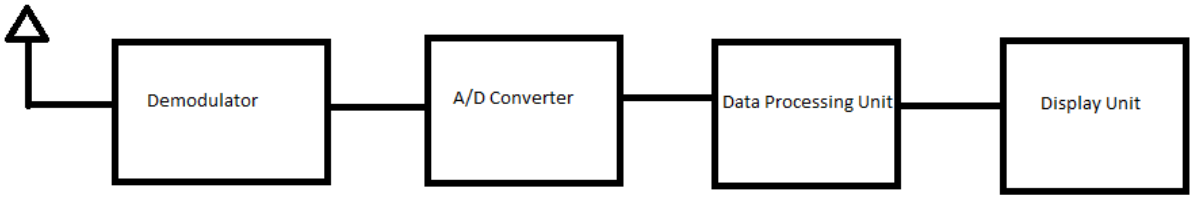
Design

Block Diagram

Transmitter



Reciever



Block Descriptions

Transmitter

-Wireless power charging device

- Passively charges the device wirelessly or
- actively charge it via a base station and inductive charging system

-Vitals Monitoring system

- Reads various vitals and translates them into analog voltages.
- Multiplexing device decides which data is transmitted
- A/D converter translates analog voltages into digital waveforms for transmissions.

-Wireless Data Transmission System

- Voltage Controlled Oscillator maps data onto the carrier
- Antenna transmits data to receiver to be demodulated for analysis

Receiver

-Demodulator

- Demodulates the waveform from the receiving antenna, removing the carrier frequency

-A/D Converter

- Symbol recognizer interprets the bits that were mapped onto the demodulated signal and reads data into processing unit

-Data processing and display unit

- Data is read into a CPU which then interprets the data, stores it and can display it in easy-to-read form.

Requirements and Verification

Requirements

- Power device should be able to effectively charge the device for an effective use of 8 hours.
- Sensor data should accurately reflect real analysis of vitals with error of less than 5%.
- Wireless transmission system should be able to successfully transmit data to receiver at distances of up to ~3 feet (or comparable to Bluetooth).

Verification

- Simulations will be conducted to determine best devices for the implementation.
- Devices will be tested on hard-board configuration. Each stage of the device should function independently of the other devices.
- Device will then be tested using flexible materials.

Tolerance Analysis

Key factors in the Tolerance Analysis will be size and power consumption. While wireless charging mechanisms have had a lot of success in previous applications, the device must still be able to effectively stay powered without the user losing the goal of mobility. Typical devices of this nature run at under 1 W (this will be our threshold). In addition, the upper limit on typical flexible electronic chip thickness is ~ .6mm. This will be the upper limit for all components used for our device. Finally, the device will need to be able to reliably transmit the data to a receiver at typical Personal Area Network (PAN) distances.

Cost and Schedule

Cost Analysis

All costs are calculated on a per-unit basis, assuming that bulk discounts are applied. Fabrication costs are to be reimbursed by the Materials Science Research group in MRL.

Part # and Description	Cost	Quantity Needed	Total
VCO (MAX2750)	$1.18	1	$1.18
Flexible Electronic Antennas (fabricated)	$10	2	$20
Local Oscillators (LTC6992)	$2.25	2	$4.50
Flexible ECG sensors (fabricated)	$600	1	$600
Sensor Amplifiers (AD627B)	$4.54	2	$9.08

Total Parts: **$634.76**

Labor: $40.00 per hour for 10 hours per week for 16 weeks for two team members.

Total Labor: $12,800 * 2.5 = **$32,000**

Total Cost: **$32,634.76**

Schedule

Week	Date	Tasks	Team Member
1	2/3 - 2/6	Write Project Proposal	Matt & Russ
	2/6	Sign up for mock design review	Matt
	2/6	Attend Fabrication Seminar -- MRL	Russ
2	All week	Create Detailed Electrical Design	Russ
	All week	Research implementation using small low power electronics	Matt
3	All week	Simulate proposed design on ADS	Matt & Russ
4	All week	Prepare for Design Review	Matt
	2/25-2/28	Design Review	Matt & Russ
	All week	Simulate and revise design	Russ
5	3/4	Order parts	Matt
	3/7	Oversee fabrication of materials	Russ
6	3/11	Individual Progress Reports	Matt & Russ
	All week	Learn how to use the reciever software / parts	Matt
	All week	Begin integration and preliminary tests	Russ
7	All week	Spring Break : Chicago 2013	Matt & Russ
	All week	Meet up to go over results of last week	Matt & Russ
	All week	Plan, decide what features are implementable given results	Matt & Russ
8	3/25	Sign up for mock-up demos	Matt
	All week	Test reciever design	Matt
	All week	Test transmitter design	Russ
9	4/1	Mock up Presentation	Russ & Matt
	All week	Test Full System with reciever and transmitter	Matt
	All week	Order additional parts, complete extra fabrication	Russ
10	4/8	Test final revision	Matt & Russ
	All week	Make necessary changes, order parts, etc	Russ
	All week	Simulate new revision	Matt
11	4/15	Test final revision	Matt & Russ
	4/15	Sign up / Prepare for Demo	Matt
	All week	Begin writing report	Russ
12	All week	Prepare for Demo	Matt & Russ
	4/22 - 4/25	Demos	Matt & Russ
13	4/29 - 4/30	Final Presentation	Matt & Russ