

Large scale **software**, especially in C and perl. TCP/IP internals, compilers, real-time work, user applications. Win32, Unix-like, and embedded platforms. With source control and other tools to manage complexity.

Board-level **electronics**: micros (ARM7, various 8-bit), radio work up to 2.4 GHz, power conversion, programmable logic, capacitive user input, slow analog, system level design.

Applications of certain **numerical algorithms**: linear algebra, signal processing for digital control and communications, computational geometry.

I am a **Canadian citizen** (visa status: TN-1).

In general, I am interested in problems that are not already well-defined areas of research. Major projects that I have completed (alone or primarily, except as described) include:

Low-Power Sensor Network, with 802.15.4

for Mitsubishi Electric Research Labs, 2006-7

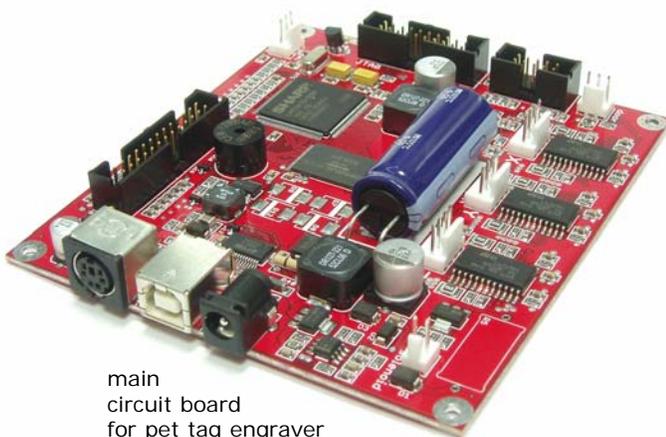
sense human motion, like for a burglar alarm; do this at many points throughout a building, collect data at a central location; then, statistical analysis of this data, to do "something interesting" (my work is the sensors, not the analysis)

wireless sensor nodes, that detect human motion (via thermal IR, using a pyroelectric element); must run from battery, ~5 year lifetime, or else installation / maintenance costs are impractical

custom analog electronics for sensor interface, to meet power target; MSP430 micro and 802.15.4 (Chipcon) radio, printed circuit board antenna

base station, to relay data over wired Ethernet; ARM7 micro, power-over-Ethernet (requires a custom DC/DC converter), software for TCP/IP

deployed at MIT Media Lab and elsewhere; and at various conferences, including SIGGRAPH 2007



main
circuit board
for pet tag engraver

Constraint-Based Drawing Program

personal project (now freeware), 2007

an easy way to specify a drawing that consists of lines: the endpoints (x_a, y_a) (x_b, y_b) of the lines

a hard way to specify the drawing: geometric constraints ("this line makes a 30 degree angle with the x-axis, is 3 inches long, and has endpoints that lie on these other two lines")

convert from the hard representation to the easy representation automatically; this is practically useful, because the "hard" representation is how a mechanical drawing is dimensioned

implementation: constraints are described as equations in a symbolic algebra system, and solved numerically by a Newton's method

this program targets 2-d output, e.g. for a laser cutter; no free or commercial software exists for this niche, and best solutions (graphics program like CorelDRAW, or 3-d CAD software, ignoring 3-d capabilities) are expensive or inconvenient

download from <http://cq.cx/sketchflat.pl>

Standalone Pet Tag Engraving Machine

on contract, for GoTags.com, LLC; 2004-7

goal: engrave aluminum tags (like for a cat or a dog), in a system that does not involve a PC

ARM7-based embedded system: PS/2 keyboard input, QVGA LCD output, graphical interface with on-screen preview of text or graphics to be engraved

x/y/z table pushes a diamond scribe into the workpiece, to scratch out the letters; driven by three stepper motors, with three bipolar PWM constant-current drives

initial development for a Win32 simulator; user interface complete before first prototype hardware

software in C for arm-elf-gcc, custom operating system, device drivers, boot loader, etc.; hardware drawn in EAGLE, produced through a contract manufacturer

buy it now, <http://goscribe.com/>

Education — University of Waterloo, *Bachelor of Applied Science in Honours Electrical Engineering*, 2005; with a *Waterloo County Special Scholarship* on entrance, Dean's List every term, *Sanford Fleming Foundation Award for Co-operative Proficiency* on graduation.

Employment History —

Mitsubishi Electric Research Laboratories; Cambridge MA

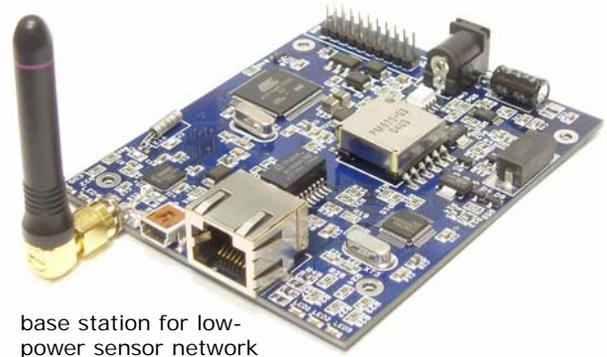
Research Associate, Jul 2005-present

board-level electronic design; scientific instruments and prototypes as required to implement research concepts, including:

high-efficiency switching power supply, to handle current into and out of an electrochemical cell, around 20 A, 1 V; all-digital control (in software on a microcontroller), for flexibility in characterizing cell infrared "slide projector;" the sequence of patterns allows a tag to discover its position in space, for motion capture and tracking (SIGGRAPH 2006,7)

capacitive user interface devices; practical circuits to measure very small capacitances, applications of these techniques, for novel interaction; includes several product-oriented demos, and an interactive fountain (SIGGRAPH 2006)

also: various mechanical work, especially for rapid prototyping of plastic parts (Stratasys FDM); in Pro/E



base station for low-power sensor network



various test equipment for RFID tags, in the context of security vulnerabilities

coverage by Wired Magazine (May 2006), NewsHour with Jim Lehrer (Aug 17, 2006), others

Xytek BV; Rijswijk, Netherlands (co-op)

Hardware/Software Developer, Aug-Dec 2004

a vehicle-tracking system—get location via GPS, report it over GPRS (cellular data) link; for airport equipment, also monitors on-board machinery

other electronics to support industrial automation

Research In Motion; Waterloo ON (co-op)

Radio Software Developer, Sep 2001-Aug 2004

software for a GSM/GPRS cellular data protocol stack; implemented LLC, SNDCP, SM, IP (loosely, reliable delivery and segmenting) layers; in C for an ARM7

a scripting language and simulator to regression-test the protocol stack, while running on a PC; design and implementation of this, in C for Win32

systems software for an ADSP-2183 DSP (on the cell phone's processor ASIC); program loader, C runtime, interface to the ARM

primary maintainer of their low-level debugging tool: real-time logging, and debugger-type features to examine and manipulate memory; in C for Win32

Scintrex Ltd.; Concord ON (co-op)

Software Developer, Jan-Apr 2001

evaluation of commercial real-time operating systems, for use in geophysical instruments; test programs for QNX Neutrino and RT-Linux

a generic prototype of an instrument, for a Motorola 68EZ328 evaluation board; various device drivers, for an LCD, keypad, analog-to-digital board

Print Publications (partial list)

ed. Garfinkel. *RFID: Applications, Security, and Privacy*. Addison-Wesley Professional, 2005. (Chapter 19, describing several attacks on proximity cards)

with Halamka et al. The Security Implications of VeriChip Cloning. *Journal of the American Medical Informatics Association*, August 2006.

with Raskar et al. LumiNetra: High Speed Scene Point Capture and Video Enhancement using Photosensing Markers and Multiplexed Illumination. *SIGGRAPH 2007*.

Software and Technologies

typical Unix tools: apache, mod_perl, qmail, mysql, IP network setup, under Linux and OpenBSD

typical Windows tools: Microsoft Office, Photoshop, Fireworks, QuarkXPress, others

for C and C++: Microsoft Visual C++ compiler, gcc (targeting x86, ARM, AVR, MSP430), tcc (for ARM)

scientific computing: LTspice (or SPICE in general), MATLAB, Maple

CAD: EAGLE for schematic capture and layout, Pro/E for mechanical drawing, especially for rapid prototyping via FDM

surface mount: fine-pitch (0.5 mm), leadless (BGA, QFN), design for automated assembly

This resume is current as of July 2007; for latest see <http://cq.cx/resume.pl>