La Trobe University
Department of Electronic Engineering

2011 Mid-Year Start Student Project List

A prospectus of projects available to final year undergraduate students enrolled in ELE4EPA for 2nd semester, and as major projects for suitably qualified masters students

8 July 2011

Introduction

This document is a prospectus of projects proposed by industry and staff in the Department of Electronic Engineering, La Trobe University for 2011. These projects are available to students in the final year of the Bachelor of Electronic Engineering (and associated double degrees) as well as suitability qualified masters by coursework students in appropriate courses offered by the Department of Electronic Engineering. This list is not exhaustive and may be updated from time to time.

Students may also propose their own project and discuss their project idea with a member of staff whose interests overlap with the proposed project area. Should the member of staff accept the proposed project as being of appropriate academic and technical merit then the student may sign up to undertake the proposed project with the member of staff as their supervisor.

Members of staff can only supervise a limited number of students (masters and final year) and may reach their limit before all projects offered by them (in this document) have been taken. Individual staff can advise on their current availability to supervise projects.

It is highly recommended that students sign up for projects early (well before the start of semester), not only to maximise their chances of getting a project and supervisor of greatest interest to them, but also to enable them to start early on their project. University tests have shown that students who get an early start on their project generally perform better, make more substantial achievements, learn more and hence, obtain better grades for their project work.

ELE4EPA and ELE4EPB

These two units make up the 45cp project for students in the final year of the Bachelor of Electronic Engineering (or 4^{th} or 5^{th} years of associated double degrees). It is the responsibility of ALL students enrolled in ELE4EPA and ELE4EPB to sign up for a project and supervisor. This is done by discussing a proposed project with a suitable member of staff and having the member of staff agree to supervise the student and project. To formalise this agreement the "ELE4EPA/EPB Engineering Project Administration Form" must be filled out, signed and submitted to the Department of Electronic Engineering Reception, BG 432. All students are expected to have commenced work on their project by the start of semester – starting late will not be accepted as a valid reason for special consideration. Any student enrolled in ELE4EPA who has NOT sign up for a project and supervisor by the end of the 2^{nd} week of semester will be required to withdraw from ELE4EPA. Project planning is a vitally important first step in project work. Project plans are due at the start of the 4^{th} week of semester (students should submit a draft to their supervisor by the start of the 3^{rd} week of semester). Any student who has not submitted a project plan by the 5^{th} week of semester (census date) will be required to withdraw from the project!

All official correspondence between the project coordinator and project students will be via the students LTU email address – so check your email regularly.

Key Dates for ELE4EPA/EPB Projects Starting 2nd Semester 2011

Monday, July 25, 2011: Start 2nd Semester 2011
Friday, July 29, 2011: Last date for submission of ELE4EPA/EPB Engineering Project Administration Forms
Monday, August 15, 2011: Project Plan Due
Friday, October 28, 2011: End 2nd Semester 2011
Week commencing Monday, October 31, 2011: Mid Project Presentations
Wednesday, November 2, 2011: Mid Year Progress Report Due
Monday, February 27, 2012: Start First Semester
Monday, May 28, 2012: Final Thesis Due
Thursday, May 31, 2012: Project Poster Due
Friday, June 1, 2012: End 1st Semester
Mon/Tue/Wed June 4, 5, 6, 2012: Final Project Presentations/Demonstrations

Major Projects for Masters by Coursework Students

Suitably qualified masters by coursework students may be offered the opportunity work on a major project as part of their masters course. To undertake a 60 credit point major project, students are normally required to have achieved average results of 75% or greater in their studies at La Trobe University so far. A student will also be required to demonstrate that enrolment in a major project will not compromise their ability to complete required units in their course. Major projects are normally conducted over two consecutive semesters.

Masters students interested in undertaking a major project should seek out a prospective supervisor from the members of staff in the Department of Electronic Engineering. Should an agreement to supervise the student be granted by the member of staff, the "Major Project – Postgraduate Coursework Administration Form" must be completed and signed by both the supervisor and the student. These forms are due by the start of semester. Staff are unlikely to agree to supervise major projects after the first week of semester.

All students are expected to have commenced work on their project by the start of semester – starting late will not be accepted as a valid reason for special consideration. Project planning is a vitally important first step in project work. Project plans are due at the start of the 4th week of semester (students should submit a draft to their supervisor by the start of the 3rd week of semester). Any student who has not submitted a project plan by the census date (~5th week of semester) will be required to withdraw from the project!

Key dates for major projects starting in 2nd semester 2011 will be the same or similar to those listed for the ELE4EPA/EPB projects, above.

All official correspondence between the project coordinator and project students will be via the students LTU email address – so check your email regularly.

Projects offered by staff not listed in this document

At time of printing not all staff in the Department of Electronic Engineering had provided project outlines. If you are interested in working on a project under the supervision of a member of staff not listed in this document please approach them directly. Some members of staff may have reached their quota of students to supervise. Individual members of staff will be able to advise on their current availability to supervise students.

Questions

Please contact the Department of Electronic Engineering Project Co-ordinator, Jim Whittington (BG436) j.whittington@latrobe.edu.au if you have any questions on the allocation of projects.

INDUSTRY PROJECTS

Integrated Debugging Environment (IDE) for Mobile Phone (Industry Project)

Sponsoring Company:
Moi www.moi-p.com

Industry Supervisor:
Dr Anthony Overmars
anthony.overmars@moi-p.com
0422 552 266

Abstract:
Based on previous work this project will use the Eclipse IDE to develop a code building and code testing interface for a real mobile phone accessing it via the JTAG port.

The project skills will require some aptitude for interfacing to undocumented hardware (hacking) of the highest order and will require mapping of memory and input output address maps. The project will form part of a much larger phone development platform which is currently being developed.

Special interests or skills in determining undocumented firmware using software probing techniques would be an advantaged, but not necessary.

On site training will be provided and all hardware and platforms will also be provided.

Required Student Skills:
C/C++ Software development;
An interest embedded processors and systems;
Some experience with FPGA design and VHDL is an advantage.

Confidentiality:
Because of the complex nature of the phone development platform a Non-disclosure agreement will need to be signed.

Uni Supervisor and contact:
Jim Whittington
Office: BG436
Email: j.whittington@latrobe.edu.au

Generic Firmware Porting on a Mobile Phone (4G)
(Industry Project)

Sponsoring Company:
Moi www.moi-p.com

Industry Supervisor:
Dr Anthony Overmars
anthony.overmars@moi-p.com
0422 552 266

Abstract:
Based on previous work this project will use existing working firmware to port to other phone vendor platforms and to develop code which automates the rapid porting of firmware to various phone platforms for real mobile phones accessing it via the JTAG port.

The project skills will require some aptitude for interfacing to undocumented hardware (hacking) of the highest order and will require mapping of memory and input output address maps. The project will form part of a much larger phone development platform which is currently being developed.

Special interests or skills in determining undocumented firmware using software probing techniques would be an advantaged, but not necessary.

On site training will be provided and all hardware and platforms will also be provided.

Required Student Skills:
C/C++ Software development;
An interest embedded processors and systems;
Experience with Linux OS an advantage.

Confidentiality:
A student working on this project will be required to sign a legal confidentiality agreement (NDA) as a number of trade secrets and methods will need to be disclosed. All the necessary training and support will be provided by Softronics.

Uni Supervisor and contact:
Jim Whittington
Office: BG436
Email: j.whittington@latrobe.edu.au

Telephone Exchange & SIP Server for Nationwide deployment (Industry Project)

Sponsoring Company:
Moi www.moi-p.com

Industry Supervisor:
Dr Anthony Overmars
anthony.overmars@moi-p.com
0422 552 266

Abstract:
A small pilot will be built and deployed in Melbourne, Adelaide and Perth.

The telephone system will be required to terminate phone numbers and route calls between each of the capital cities based upon their dial codes.

All hardware will be provided but potential candidates will need to explore what hardware will be best suited to the task and then program and deploy and test.

The project skills will require some aptitude for interfacing to undocumented hardware of the highest order and will require some aptitude for telephony systems. The project will form part of a much larger phone development platform which is currently being developed.

Special interests or skills in determining undocumented features using software probing techniques would be an advantaged, but not necessary.

On site training will be provided and all hardware and platforms will also be provided.

Required Student Skills:
C/C++ Software development;
An interest embedded processors and systems as applied to telephony systems;
Knowledge and interest in packet switch servers and networking an advantage.

Confidentiality:
Because of the complex nature of the phone development platform a Non-disclosure agreement will need to be signed.

Uni Supervisor and contact:
Jim Whittington
Office: BG436
Email: j.whittington@latrobe.edu.au

Vehicle Independent Speedometer (Industry Project)

Sponsoring Company:
Howard Instruments Pty. Ltd.

Industry Supervisor:
Ian Howard

Abstract:

"Howard Instruments is involved in the calibration of original equipment instrumentation and the installation of aftermarket instrument and control systems as well as complementary products in automotive and commercial vehicles.

The history of the accuracy of vehicle speedometers has always been related to a number of variable factors which require instrument manufacturers to calibrate speedometers to read more than the actual speed of the vehicle. These variables include: tyre circumference; differential ratio; gearbox output; tyre pressure; tyre temperature; and vehicle weight.

The current Australian Design Rule for speedometers, ADR 18/03 requires that all vehicles sold in Australia, whether locally produced or imported should have a speedometer that does not read less than the true speed of the vehicle and can read more than the true speed of the vehicle by up to +10% plus 6 kilometres per hour. At a true speed of 100km/hr the speedo can therefore read up to 116km/hour. Clearly, in this age of advanced technology it must be possible to provide better performance.

Howard Instruments has made a submission to the State Government Committee reviewing the Australian Design Rules and we have stated that the Federal Government should see the speedometer as a safety device in all motor vehicles.

Students have worked on this for a couple of years now and have come up with a number of ideas for the development of an electronic speedometer that does not rely on any variable inputs, such as those listed above. However, once a prototype is produced its performance needs to be validated (tested and calibrated). To do this an accurate test platform is required. This is the focus of this particular project. An electronically controlled bench top test platform is required that can that can accurately move a small plate (to which the vehicle independent speedometer prototype will be attached) at reproducible accelerations and speeds. Howard Instruments can provide support for the construction of the mechanical portion of the test jig."

Desirable Student Skills:
Embedded systems, hardware & software development
Interest in market research
Interest in automotive mechanics and electrical systems

Confidentiality:
A students working on this project may have access to commercial material of a confidential nature, as such, a legal confidentiality agreement may be required.

Industry contact:
Ian Howard
Howard Instruments
110 Northern Road, Heidelberg Heights. Vic 3081
Phone: 9457 4755
howardinstruments@bigpond.com

Uni contact:
Jim Whittington
Office: BG436
Email: j.whittington@latrobe.edu.au

Universal TFT Gauge.
(Industry Project)

Sponsoring Company:
Howard Instruments Pty. Ltd.

Industry Supervisor:
Ian Howard

Abstract:
Howard Instruments is involved in the calibration of original equipment instrumentation and the installation of aftermarket instrument systems and complementary products in automotive and commercial vehicles.

Since gauges were first made, each gauge produced, indicated a specific unit, such as temperature in degrees Celsius on a scale such as 40 deg C to 120 deg C. This meant that manufacturers had to invest large sums of money in tooling, storage and distribution. Distributors in turn were required to hold large stock levels to cover the full range of gauges and pay tax on the level of stock. To reduce the physical stock quantity yet be able to supply the customer with a gauge that meets their required unit and scale, a programmable gauge would be a great technical, cost, stock and tax advance.

This project involves the development of a small gauge with a TFT screen that can be programmed to indicate a variety of units and scales. The project should produce one gauge that demonstrates the technologies involved using a TFT screen.
(a) Artwork on the dial. i.e. colours, graduations and unit identification.
(b) A unit of measurement such as temperature, pressure or fuel level.
(c) An appropriate scale.
(d) The ability to use analogue or data inputs.

An essential part of the project will be comprehensive testing of the TFT gauge in an automotive environment. This is likely to require significant test planning and development of test interfaces.

Desirable Student Skills:

- Embedded processors and 'C' programming
- An interest in automotive electrical/electronic systems

Confidentiality:
A students working on this project may have access to commercial material of a confidential nature, as such, a legal confidentiality agreement will likely be required.

Industry contact:
Ian Howard
Howard Instruments Pty. Ltd.
03 94574755
howardinstruments@bigpond.com

Uni contact:
Jim Whittington
Office: BG436
Email: j.whittington@latrobe.edu.au

Mobile Automotive Telemetry System
(Industry Project)

Sponsoring Company:
Howard Instruments Pty. Ltd.

Industry Supervisor:
Ian Howard

Abstract:
Howard Instruments is involved in the calibration of original equipment instrumentation and the installation of aftermarket instrument systems and complementary products in automotive and commercial vehicles.

Howard Instruments is interested in developing a system for sensing a wide range of parameters related automobiles in normal day to day operation (i.e. on the move) and sending that information to another location, which could be a mobile phone or computer (desktop or laptop). Data detected could include: air analysis, temperature sensing, pressure sensing or chemical sampling. This project may well have a number of other applications in medical, environmental, military and security fields.

Desirable Student Skills:

- Embedded processors and 'C' programming
- Some communication system knowledge
- An interest in automotive electrical/electronic systems

Confidentiality:
A students working on this project may have access to commercial material of a confidential nature, as such, a legal confidentiality agreement will likely be required.

Industry contact:
Ian Howard
Howard Instruments Pty. Ltd.
03 94574755
howardinstruments@bigpond.com

Uni contact:
Jim Whittington
Office: BG436
Email: j.whittington@latrobe.edu.au

Intermodulation Detector
(Industry Project)

Sponsoring Company:
ASI limited

Industry Supervisor:
Allister Babington

Abstract:
Project to develop a digital controller of two RF transmitters and one RF receiver to use as a detector of Passive Intermodulation (PIM). Passive Intermodulation causes interference to radio signals and is a continuing problem with radio sites as more services are added.
RF transmit frequencies mix together in transmission coax or on metal structures and mounts to produce harmonics which are unwanted and are picked up by RF receivers as PIM interference.
Object is to develop and market a range of products to meet worldwide demand for instruments to locate PIM interference.
ASI Limited has been manufacturing PIM detectors for over 10 years and will provide project scope, design requirements, filters and combiners, field experience, and technical design expertise based on the range of equipment already supplied by ASI Limited to the market place.
La Trobe to provide design for the electronic generation and control of the hardware.

The following frequency ranges are required initially for development.
VHF
VHF Tx 1 From 136Mhz to 174 Mhz
VHF Tx 2 From 136Mhz to 174 Mhz
VHF Rx 1 From 98 Mhz to 212 Mhz (Third Harmonics of Tx 1 and Tx 2).

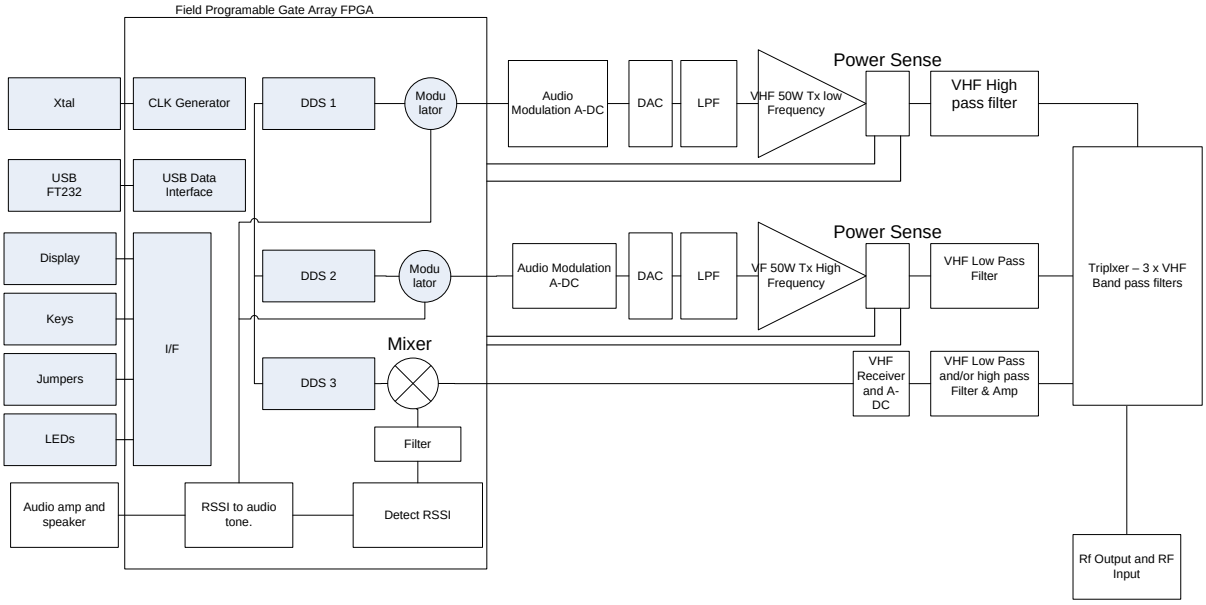
Appropriate RF filters will be selected to suit band width limitations and regulations on transmission.

Other frequency ranges are for future development.

The output transmit power is to be adjustable from 25 mW (+14 dBm) to 20 watts (+43 dBm). If available 40 watts (+46 dBm)
The receiver sensitivity to be -124 dBm with 10 db signal to noise or better in a 3 kHz channel bandwidth. The use of digital techniques to improve the receiver sensitivity by reducing bandwidth is desired.

A digital interface is required to control and display frequency or channel, levels of power and receive signal. This is displayed as a ratio between transmit power and receiver input level, this is referred to as dB below carrier (dBc).
Preset set up of frequencies and levels are desired for operator ease, these may be set using a computer interface. Alpha numeric display.
Changes to the frequency of transmitters (and automatically the receive frequency) is desired for a field operator to move away from site interference that may be present.

A basic block diagram of the proposed system is shown below



Required Student Skills:
There may be scope in this project to support more than one student. Skill coverage of one or more of the following will be essential.

- FPGA design and testing with VHDL coding;
- DSP, digital design and communication system fundamentals;
- RF Design

Industry contact:
Allister Babington
ASI limited
45 Thomson Street
Invercargill
New Zealand
asiltd@woosh.co.nz

Uni contact:
John Devlin
Office: BG434
Email: j.devlin@latrobe.edu.au

Design and development of 5.8GHz RFID tag reader (Industry Project)

Sponsoring Company:
Centre for Technology Infusion (CTI)

Industry Supervisor:
Dr Kriyang Shah

Abstract:

Radio Frequency Identification (RFID) find many applications in security, food safety, surveillance, logistics, transportation and agriculture industry for retail inventory management and asset tracking. Large RFID deployments exist in Ultra High Frequency (UHF) and Very High Frequency (VHF) bands but none of the current RFID systems operate in the unlicensed Super High Frequency (SHF) band.

This project aims at design and development of an SHF band RFID Tag reader system. This will include integration of a 5.8GHz transceiver system with an Antenna on a PCB followed by firmware design for the integrated system. The design system will follow the EPC standard for system design and provide software design of necessary routines for read and write cycles for an SHF tag. The integrated system will also provide an interface to PC system for system configuration and selection of Tag parameters via a graphical user interface.

Maximum of (5) students can work on various features of this project. While each student will work on an individual component, with individual specifications, testing, qualification and reporting, some joint work may be conducted on integration of various parts to produce a final system.

Required Student Skills:

Good knowledge of communication theory and programming skills is required.

Contacts:

Dr Kriyang Shah
Office: Centre for Technology Infusion; phone: 9479 5221
Email: K.Shah@latrobe.edu.au

Design and development of SHF-to-DC conversion system for RFID tags
(Industry Project)

Sponsoring Company:
Centre for Technology Infusion (CTI)

Industry Supervisor:
Dr Kriyang Shah

Abstract:
Radio Frequency Identification (RFID) find many applications in security, food safety, surveillance, logistics, transportation and agriculture industry for retail inventory management and asset tracking. Large RFID deployments exist in Ultra High Frequency (UHF) and Very High Frequency (VHF) bands but none of the current RFID systems operate in the unlicensed Super High Frequency (SHF) band. This project aims at design and development of an SHF band passive RFID Tag system which is powered by a SHF reader. The primary challenge in passive RFID tag design is to convert power received via the SHF link to necessary DC voltage to operate the control system within the Tag. This project includes design of a fully on-chip SHF-to-DC conversion system. The chip will be designed in 0.18um CMOS technology using industry standard electronic design automation (EDA) tools. Maximum of (2) students can work on various features of this project. While each student will work on an individual component, with individual specifications, testing, qualification and reporting, some joint work may be conducted on integration of various parts to produce a final system.

Required Student Skills:
Good knowledge of communication theory, circuit design and primary knowledge of some EDA tools are required.

Contacts:
Dr Kriyang Shah
Office: Centre for Technology Infusion; phone: 9479 5221
Email: K.Shah@latrobe.edu.au

Developing a waveform transformation processing algorithm and/or software for auditory to tactile signal conversion (Industry Project)

Sponsoring Company:
Centre for Technology Infusion (CTI)

Industry Supervisor:
Dr Kriyang Shah

Abstract:
Auditory and tactile HMI are closely related and current research aims to show the best method for using auditory signals as a learning scaffold for future tactile displays. Signals within the normal auditory perception bandwidth have typical frequencies between 20Hz-8kHz whereas tactile perception operates between 0.1Hz-1kHz. Other waveform characteristics such as timing and amplitude will also require transformation to correlate with optimum tactile characteristics.
It is envisaged that this can be achieved through a signal processing algorithm or software which can be integrated within a future HMI. A filter concept similar to MATLAB Signal Toolbox methodology is proposed which enables transformation of one signal waveform to another through a user-defined variable stepwise design method operating on all aspects of the signal waveform including frequency, amplitude and temporal characteristics.
The finished product would enable a researcher or HMI designer to control all aspects of the auditory to tactile bandwidth transformation so as to customise each to optimum characteristics. This could be teamed with an extraneous noise filtration method to reduce or eliminate nuisance noise and enhance perception of HMI signals or warnings.
Up to three (3) students can work on various components of this system. While each student will work on an individual component, with individual specifications, testing, qualification and reporting, some joint work may be conducted on integration of various parts to produce a final system.

Required Student Skills:
Knowledge of electronics engineering and some programming skills required.

Contacts:
Dr Kriyang Shah
Office: Centre for Technology Infusion; phone: 9479 5221
Email: K.Shah@latrobe.edu.au

Design and development of broadband over power line to Zigbee bridge
(Industry Project)

Sponsoring Company:
Centre for Technology Infusion (CTI)

Industry Supervisor:
Dr Kriyang Shah

Abstract:
The research project will involve development of a communication bridge between HomePlug AV as wired communication standard for broadband over power line and Zigbee as wireless communication standard. Integration of broadband over power line module with a Zigbee transceiver module on a single board will enable remote reading and management of Zigbee enabled energy, gas and water meters over secured in-house wired communication link. This project will also involve design of embedded firmware and a protocol stack required for this bridge module.
Up to five (5) students can work on various components of this system. While each student will work on an individual component, with individual specifications, testing, qualification and reporting, some joint work may be conducted on integration of various parts to produce a final system.

Required Student Skills:
Good knowledge of digital design, receiver and communication system fundamentals.

Confidentiality:
A students working on this project may have access to commercial material of a confidential nature, as such, a legal confidentiality agreement may be required.

Contacts:
Dr Kriyang Shah
Office: Centre for Technology Infusion; phone: 9479 5221
Email: K.Shah@latrobe.edu.au

Expansion of tactile HMI displays
(Industry Project)

Sponsoring Company:
Centre for Technology Infusion (CTI)

Industry Supervisor:
Dr Kriyang Shah

Abstract:
Tactile displays can be projected anywhere on the skin surface, subject to convenience and comfort. The hands are very sensitive tactile receptors and a HMI based on a glove has been proposed as a method of expanding the tactile domain. However, typical experimental methods for tactile stimulation of the hand preclude its use for anything else, primarily due to the bulk of the apparatus. If miniature tactile arrays can be constructed which allow tactile stimulation whilst allowing the hand to be used for other purposes, the fidelity advantage of this glabrous skin area can be better utilised.
It is proposed that Micro-electromechanical systems (MEMS) or similar technology could be applied to provide tactile stimulation whilst still allowing the hand to be used for the range of uses typically associated with the driving task, such as grasping, holding and pushing. Alternatively, the steering wheel could be used as the transduction method for the tactile frequency bandwidth of 0.1Hz-1kHz. Displacement characteristics range between -20 – 40dB (1.0um peak) over this band. Transformation and noise reduction methods above could dovetail with this project.

Required Student Skills:
Psychophysics/computer science/computer engineering/electronics engineering, some programming skills.

Contacts:
Dr Felix Acker
Office: Centre for Technology Infusion; phone: 9479 5221
Email: F.Acker@latrobe.edu.au

Design and development of ultra low power digital standard cell library using near threshold logic (Industry Project)

Sponsoring Company:
Centre for Technology Infusion (CTI)

Industry Supervisor:
Dr Kriyang Shah

Abstract:
The research project will involve design and development of digital standard cells including standard logic gates, flip-flops and Input/output buffers using near threshold logic design. The designed cells will be fully characterised for their static, dynamic and leakage power consumptions along with other performance parameters like delay and maximum operating frequency. The digital cells will be designed in 90nm standard CMOS process with possible scalability to 45nm CMOS process. The design standard cells will be further tested in different digital designs like counters, adders, arithmetic and logic unit, memory module and others.
Up to three (3) students can work on various components of this system. While each student will work on an individual component, with individual specifications, testing, qualification and reporting, some joint work may be conducted on integration of various parts to produce a final system.

Required Student Skills:
Good background in electronic engineering and/or computer science/computer engineering.

Confidentiality:
A students working on this project may have access to commercial material of a confidential nature, as such, a legal confidentiality agreement may be required.

Contacts:
Dr Kriyang Shah
Office: Centre for Technology Infusion; phone: 9479 5221
Email: K.Shah@latrobe.edu.au

Design and development of Micro/Nano-electromechanical systems (MEMS/NEMS) based receiver in 10-20GHz band (Industry Project)

Sponsoring Company:
Centre for Technology Infusion (CTI)

Industry Supervisor:
Dr Kriyang Shah

Abstract:
Micro/Nano electromechanical systems have been the enabling technology for high performance low power receiver systems in low GHz frequency range. However, in 10-20GHz frequency range the performance of MEMS/NEMS components has been the inhibiting factor for MEMS/NEMS based transceivers in that range. The research project will involve design and development of an integrated 2-channel PLL less, on-off keying (OOK) based, receiver system which includes filters, oscillator, low noise amplifier and mixer based on MEMS/NEMS resonators and inductors.
Up to four (4) students can work on various components of this system. While each student will work on an individual component, with individual specifications, testing, qualification and reporting, some joint work may be conducted on integration of various parts to produce a final system.

Required Student Skills:
Good knowledge of digital design, receiver and communication system fundamentals.

Contacts:
Dr Kriyang Shah
Office: Centre for Technology Infusion; phone: 9479 5221
Email: K.Shah@latrobe.edu.au

Alfred Hospital Biomedical Engineering Project
(Biomedical Engineering Industry Project)

Host Organization: **Alfred Hospital, Commercial Road Prahran**
Industry Supervisors: **Hospital Biomedical Engineering Staff**

Abstract:
Typically in conjunction with a hospital clinical department, the specifics of a project topic in physiological measurement or a related aspect of biomedical engineering may be determined and developed during a student work experience period with the Biomedical Engineering Department of the Alfred Hospital.

Confidentiality:
Depending on the nature of any intellectual property relating to the project, students may be required to enter into a non-disclosure agreement.

Required Student Background & Attributes:
Selected students in Biomedical Engineering exhibiting dedication and commitment.

Contact and University Supervisor:
Paul Junor
Office: PS2 128
Email: p.junor@latrobe.edu.au

Austin and Mercy Hospital Biomedical Engineering Project
(Biomedical Engineering Industry Project)

Host Organization: **Austin/Mercy Hospitals Studley Road Heidelberg**
Industry Supervisors: **Hospital Biomedical Engineering Staff**

Abstract:
Typically in conjunction with a hospital clinical department, the specifics of a project topic in physiological measurement or a related aspect of biomedical engineering may be determined and developed during a student work experience period with the Medical Engineering Department of the Austin Hospital or Biomedical Engineering Department of the Mercy Hospital.

Confidentiality:
Depending on the nature of any intellectual property relating to the project, students may be required to enter into a non-disclosure agreement.

Required Student Background & Attributes:
Selected students in Biomedical Engineering exhibiting dedication and commitment.

Contact and University Supervisor:
Paul Junor
Office: PS2 128
Email: p.junor@latrobe.edu.au

Royal Melbourne Hospital Biomedical Engineering Project (Biomedical Engineering Industry Project)

Host Organization: **Royal Melbourne Hospital Grattan St. Parkville**
Industry Supervisors: **Hospital Biomedical Engineering Staff**

Abstract:
Typically in conjunction with a hospital clinical department, the specifics of a project topic in physiological measurement or a related aspect of biomedical engineering may be determined and developed during a student work experience period with the Clinical Engineering Department of the Royal Melbourne Hospital.

Confidentiality:
Depending on the nature of any intellectual property relating to the project, students may be required to enter into a non-disclosure agreement.

Required Student Background & Attributes:
Selected students in Biomedical Engineering exhibiting dedication and commitment.

Contact and University Supervisor:
Paul Junor
Office: PS2 128
Email: p.junor@latrobe.edu.au

Royal Children's Hospital Biomedical Engineering Project (Biomedical Engineering Industry Project)

Host Organization: **Royal Children's Hospital Flemington Rd. Parkville**
Industry Supervisors: **Hospital Biomedical Engineering Staff**

Abstract:
Typically in conjunction with a hospital clinical department, the specifics of a project topic in physiological measurement or a related aspect of biomedical engineering may be determined and developed during a student work experience period with Biomedical Engineering Department of the Royal Children's Hospital.

Confidentiality:
Depending on the nature of any intellectual property relating to the project, students may be required to enter into a non-disclosure agreement.

Required Student Background & Attributes:
Selected students in Biomedical Engineering exhibiting dedication and commitment.

Contact and University Supervisor:
Paul Junor
Office: PS2 128
Email: p.junor@latrobe.edu.au

ENGINEERING & RESEARCH PROJECTS

Train Velocity Control using Matlab (Research Project)

Abstract:
To design a system for velocity control of a train that ensures that the actual velocity is within a specified percentage of the desired range.

The project involves:

- A continuous-time model of the DC motor and the train in the form of mechanical and electrical equations.
- Open-loop analysis in both time and frequency domains.
- Control configuration.
- Velocity controller design and evaluation.

Required Student Skills:
Strong Matlab (and in particular Simulink) programming skills
Theoretical research
Familiar with feedback control theory

Supervisor and contact:
Song Wang
Office: BG442
Email: song.wang@latrobe.edu.au

Design of Cancellable Fingerprint Templates (Research Project)

Abstract:
To design cancellable fingerprint templates such that in case a fingerprint image or template is compromised (e.g. stolen), a new biometric template can be reissued.

The project involves:

- Study of Fingerprint recognition
- Literature survey of the current state-of-art
- Minutiae point representation
- Fingerprint template generation
- Fingerprint matching

Required Student Skills:
Strong Matlab programming skills

Theoretical research
Familiar with image processing fundamentals

Supervisor and contact:
Song Wang
Office: BG442
Email: song.wang@latrobe.edu.au

Limited Word Vocabulary Recognition using Wavelets and Neural Networks (Research Project)

Abstract:
The aim is to be able to automatically recognize simple spoken words like “zero”, “one”, ……, using a computer / microprocessor. This project will examine the feasibility of using wavelets as a feature extraction tools to be used as inputs to the neural network which performs the task of recognition. It will involve some research to determine what type of wavelet decomposition will give good recognition performance and the limitations of the system. The outcome of the project will be a software platform that implement the algorithms and enable the user to test and perform recognition.

Required Student Skills:
Good knowledge in DSP and mathematics.
Good programming/debugging skills in Matlab and C.

Supervisor and contact:
David Tay
Office: BG440
Email: d.tay@latrobe.edu.au

Digital Watermarking using Quantization Index Modulation (QIM) (Research Project)

Abstract:
This is a **research type** of project which will first involve reviewing watermarking algorithms based on Quantization Index Modulation. The second part of the project will involve implementing several of the algorithms in Matlab for testing the performance of the algorithms and for demonstration purposes. The outcome of the project will be a software platform that implement the algorithms and enable the user to test and perform watermarking.

Required Student Skills:
Good knowledge in DSP and mathematics.
Good programming/debugging skills in Matlab.

Supervisor and contact:
David Tay
Office: BG440
Email: d.tay@latrobe.edu.au

Wavelet Filter Bank Design and Evaluation (Research Project)

Abstract:
This is a **research type** of project to implement design algorithms on a GUI driven user-friendly platform. Both Matlab and web-browser based platforms will be considered. User-friendly platforms for evaluation in applications such as denoising will also be considered. Algorithms such as Zero Pinning, developed by A/Prof. Tay, will be implemented. The outcome of the project will be a user friendly software platform that can be accessed by anyone through the web for design and evaluation.

Required Student Skills:
Good knowledge in DSP and mathematics.
Good programming/debugging skills in Matlab, web-based programming utilizing (Java) applets.

Supervisor and contact:
David Tay
Office: BG440
Email: d.tay@latrobe.edu.au

CUDA-Based Image Processing (Research Project)

Abstract:
In the past two years, there has been rapid development in using graphics processors (GPU) as a low cost parallel processing engine. CUDA is a software development platform for NVIDIA's GPUs. The aim of this project is to implement a state-of-the-art de-hazing algorithm using CUDA. Through this project, the student will learn programming in CUDA and optimize the software.

Required Student Skills:
Basic knowledge of C and Matlab.

Supervisor and contact:
Dr Dennis Deng
Office: BG439
Email: d.deng@latrobe.edu.au

Design and Construction of Short Range Inductive Coupled Personal Area Network Node (Transceiver) (Engineering Project)

Abstract:
Contactless near field communication system and sensing using magnetic induction (MI) is emerging as a major technology for contactless short range communication in mobile communication devices, payment cards, embedded medical devices, underground communications and personal area networks. MI is a superior alternative to Bluetooth and ultra wideband systems because they are highly secure over the short range of communication around the transceiver. To ensure the possibility of small form factor devices, software defined radio (SDR) algorithms implemented on FPGA are the preferred approach aimed at miniaturisation. The objective in this project is to implement an MI transceiver either using a microcontroller (Figure 1) or directly in an FPGA system (Figure 2) using an RLC coil as the antenna. Using FPGA all the components including the oscillator, modulators (QPSK, QAM or BPSK) and phase shifters will be implemented inside and loaded onto the FPGA and connected to the inductive coil (antenna). The student will benefit from our existing preliminary designs. The target transmission rate and range are 100kbps and 5m respectively.

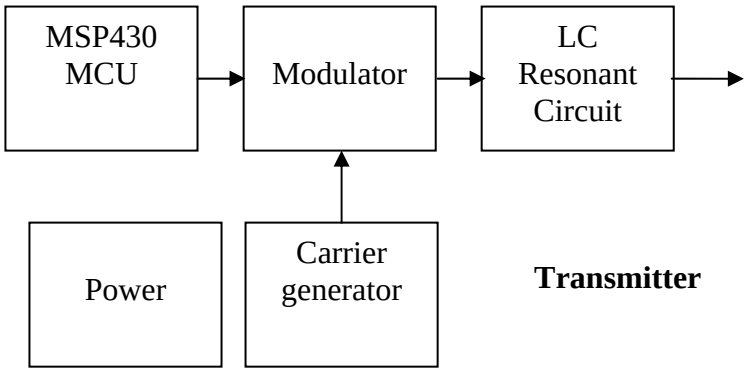


Figure 1: MI Transceiver Using a Microcontroller

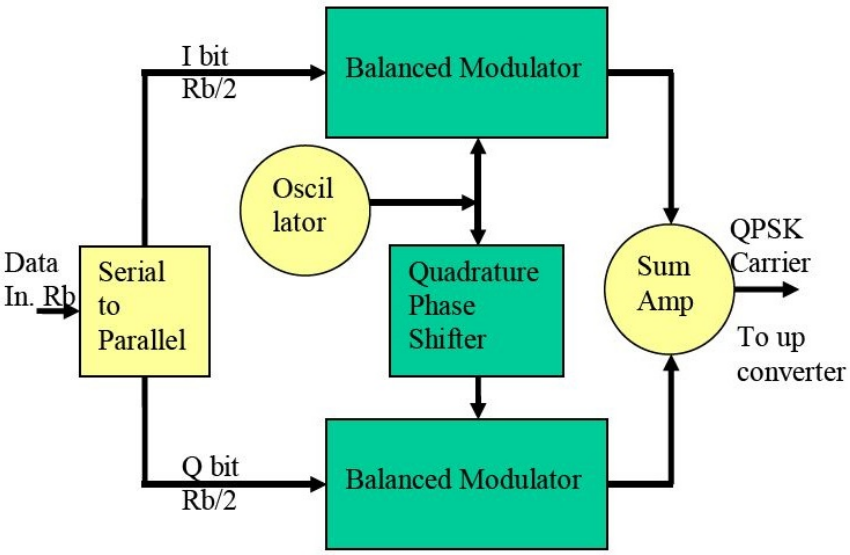


Figure 2: MI Transceiver Based on FPGA

Area: Communications Systems

Required Skills:
Knowledge of Matlab and FPGA Design

Supervisor and contact:
A/Prof Johnson Agbinya
Office: PS2 119
Email: j.agbinya@latrobe.edu.au

Design and Construction of Magneto-Inductive Waveguide (Engineering Project)

Abstract:
Magnetic induction (MI) systems operate typically over very short range (a few meters) and are highly resilient to the impact of the communication medium, withstand multipath effects and fading due to the environment. Hence they are sought after for underground communication in the coal mine and oil and gas operations. They however are not suitable yet for terrestrial communication because of the limited transmission range. One of the approaches for extending the range uses magneto-inductive waveguide which we have investigated extensively. The simplest magneto-inductive waveguide is in the form of a finite array *(N* elements) of capacitively-loaded resonant loops each of radius r_c placed at a distance *d* from each other as shown in Figure 1. The presence of a capacitance in each loop is necessary to ensure the existence of propagating longitudinal waves. The array is excited by a voltage V of frequency ω in loop **1,** and the waveguide is terminated by a load impedance of $Z_L = R_L + jX_L$ in the last element. The termination is aimed at preventing reflected waves back into the waveguide. Reflected waves reduce the capacity and performance of the waveguide. The objective in this project is for you to design, build and test a magneto-inductive waveguide which operates over a range of about 20m using 5 to 10 relaying nodes (MI coils).

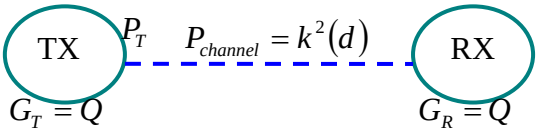


Figure 1: Peer-to-Peer MI system

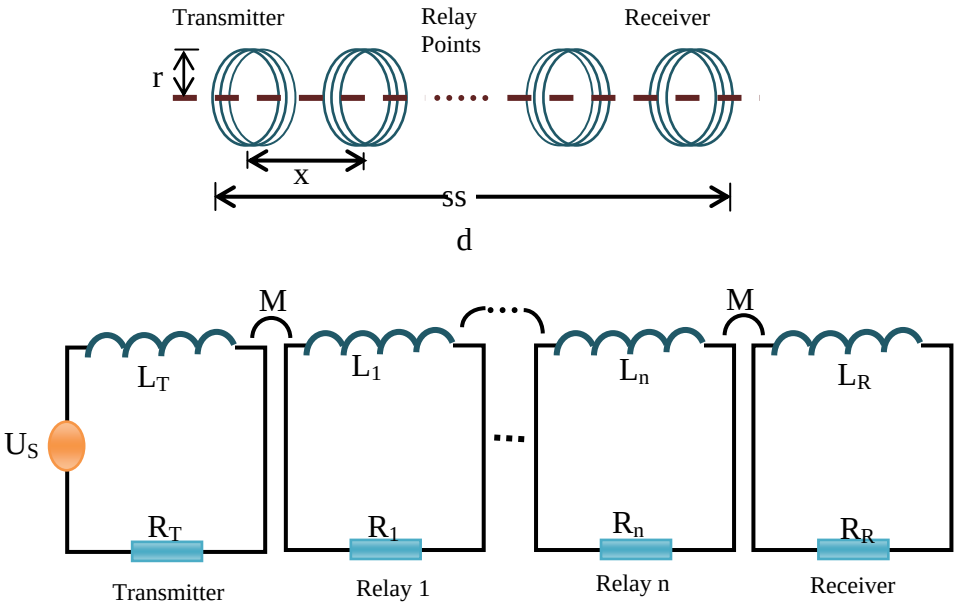


Figure 2: RLC circuit Model of MI Waveguide

Area: Communications Systems

Required Skills:
Knowledge of Matlab, electronic circuits/pcb design and FPGA Design

Supervisor and contact:
A/Prof Johnson Agbinya
Office: PS2 119
Email: j.agbinya@latrobe.edu.au

Solar Energy Based Inductive Power Coupled Charger for Hand Held Devices
(Engineering Project)

Abstract:
Green power generation and transmission as well as hands-free and wire-free power distribution and charging are of great interest at the moment. Also energy scanvenging and wireless power transmission using magnetic induction loops combined with solar cells as the source of power is seen as one of the most promising candidates for power generation in rural areas and also for self-powered electronic devices. The objective in this project is to design and implement a small power charger whose input is the output of a small solar cell inverted to produce a sinusoidal input for the magneto-inductive system. Other forms of input source could be used as replacement for the solar cell. The design should have a power charging mechanism as in power adaptors and capable of charging a AA battery or a selected re-chargeable battery of your choice. The key objective is a demonstration of feasibility rather than the accuracy of design and efficiency of charging.

Area: Green Power / Communications Systems

Required Skills:
Knowledge of Matlab, electronic circuits/pcb design and FPGA Design

Supervisor and contact:
A/Prof Johnson Agbinya
Office: PS2 119
Email: j.agbinya@latrobe.edu.au

Wireless Power Transmission Using Near Field Inductive Coupling
(Engineering Project)

Abstract:
Wireless power broadcasting could replace a lot of the unsightly power transmission cables near homes in our streets including buried cables. Other areas of interest include inductive roads powering magneto-inductive vehicles. In an environment where devices and systems require low power consumption, power can be supplied based on innovative power broadcasting methods. Broadly speaking, MI power broadcasting (MIPB) is a method whereby an inductive power source is created and couples its flux to neighbouring coil systems.
The objective in this project is to design and implement a scalable wide area network of wireless power distribution system for several nearby homes. The scalability could be in powering many homes (suburb)s as well as in the power being received in a particular home. The focus should be on magnetic induction methods.

Area: Green Power / Communications Systems

Required Skills:
Knowledge of Matlab, electronic circuits/pcb design

Supervisor and contact:
A/Prof Johnson Agbinya
Office: PS2 119
Email: j.agbinya@latrobe.edu.au

Magneto-Inductive MIMO System (Engineering Project)

Abstract:
Internet of things (IoT) has emerged as a major desire of industry to network things including home appliances, equipment and biological entities. A few technologies which support this objective include short range communication, Internetworking, sensor networks and web, trust constructs and security systems and database design. The objective of this project is to develop a small sensor web, a software tool which accepts outputs from various sensor types distributed over a wide geographical area. The site to be created is accessible remotely permitting updating, reconfiguration, search and graphical analysis of sensed or stored data.

Area: Communications Systems

Required Skills:
Knowledge of basic Matlab, MIMO systems, electronic circuits/pcb

Supervisor and contact:
A/Prof Johnson Agbinya
Office: PS2 119
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Hand-Held LED Lamp (Engineering Project)

There is always the need to consume less power and to provide cost effective sources of energy. Light emitting diodes (LEDs) are at the moment popular as sources of power and interfaces in many consumer electronics. They are also being used as replacement for incandescent lamps. The objective of this project is to design and implement a rechargeable focused high-intensity LED lamp based on LED arrays. It should produce uniform light intensity at about 40cm from the source and thereafter die off rapidly.

Area: Engineering Systems

Required Skills:
Knowledge of Matlab, sensors, electronic circuits/pcb design

Supervisor and contact:
A/Prof Johnson Agbinya
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Low Power/Cost HF SSB Digital Transceiver (Engineering Project)

Abstract:
This project involves the development of a low power/cost portable HF SSB Digital Transceiver using FPGA technology. The work will draw heavily on the higher power and cost digital transceiver developed in the department for the TIGER 3 radar. The student will be expected to layout a multi-layer circuit board for a Spartan 3A DSP or Spartan 6 FPGA (or equivalent). A digital transceiver will then be designed and implemented in the FPGA.

Required Student Skills:

- Quality PCB Layout;
- FPGA design and testing with VHDL coding;
- Matlab.

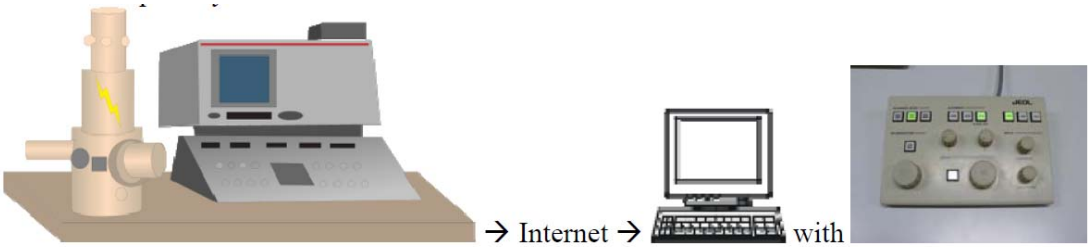
Supervisor and contact:
John Devlin
Office: BG434
Email: j.devlin@latrobe.edu.au

Remote Electron Microscope Operation System (Engineering Project)

Abstract:
The Electron Microscope Facility at La Trobe University hosts a number of different scanning and transmission electron microscopes manufactured by JEOL. These microscopes are used in the investigation of solid and biological material for imaging and elemental analysis. Detail about La Trobe's Electron Microscope Facility can be found a www.latrobe.edu.au/scitecheng/EMfacility/. JEOL is a leading international company in developing, manufacturing and maintaining electron microscopes around the world http://www.jeol.com/. JEOL Australia are in high demand to install and maintain electron microscopes, and hence are seeking qualified electronic and physical engineers.

The scanning electron microscope is operated via operation panel, mouse, keyboard and monitor. The operation of the microscope requires the physical presence at the instrument which is inconvenient and costly for our rural colleges in Bendigo.
The project aims to improve the accessibility with a operation station located in Bendigo to operate the microscope located in Bundoora. These will allow to operate the instrument remotely for research, training and teaching.

This project involves the development of an interface to connect the microscope to a second operation station in Bendigo. The interface with input and output will transfer the instrument status, screen information and operation panel between microscope and remote control station. The remote control station will have secondary input privilege to the instrument input to maintain priority.



Scanning electron microscope connected via interface to a second operation panel for remote access.

Required Student Skills:

- This is a challenging project for a high achieving student, or possibly two students working on different parts;
- Ethernet communications;
- Control Systems
- Embedded Systems.

Supervisor and contact:
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