# La Trobe University
# Department of Electronic Engineering

# 2010 Student Project List

***A prospectus of projects available to final year undergraduate students enrolled in ELE4EPA and ELE4EPB, and as major projects for suitably qualified masters students***

**16 December 2010**

## Introduction

This document is a prospectus of projects proposed by industry and staff in the Department of Electronic Engineering, La Trobe University for 2010. 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 census date (~$5^{th}$ week of semester) 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 1st Semester 2010

**Friday, February 26, 2010**: Due date for submission of ELE4EPA/EPB Engineering Project Administration Forms
**Monday, March 1, 2010**: Start 1st Semester 2008
**Monday, March 22, 2010**: Project Plan Due
**Monday, May 31, 2010**: Mid Year Progress Report Due
**Week commencing Monday, May 31, 2010**: Mid Year Presentations
**Friday, June 4, 2010**: End 1st Semester 2009
**Monday, July 26, 2010**: Start Second Semester
**Wednesday, October 27, 2010**: Final Thesis Due
**Friday, October 29, 2010**: End 2nd Semester
**Mon/Tue/Wed November 1, 2, 3, 2010:** 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 45 or 60 credit point (as appropriate to the course being studied) 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 postgraduate coursework co-ordinator. 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 1st semester 2010 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:**
Softronics www.softronx.com

**Industry Supervisor:**
Dr Anthony Overmars
ao@softronx.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:**
Softronics www.softronx.com

**Industry Supervisor:**
Dr Anthony Overmars
ao@softronx.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
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Email: j.whittington@latrobe.edu.au

## Telephone Exchange & SIP Server for Nation wide deployment (Industry Project)

**Sponsoring Company:**
Softronics www.softronx.com

**Industry Supervisor:**
Dr Anthony Overmars
ao@softronx.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
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Email: j.whittington@latrobe.edu.au

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# Impressed Current Cathodic Protection Control System using a Fuzzy Logic Approach (Industry Project)

**Sponsoring Company:**
M. Brodribb Pty Ltd

**Industry Supervisor:**
Richard Brodribb

**Abstract:**
Impressed current cathodic protection systems operate by passing current from an anode through a conductive path (soil, water etc) and to the protected structure. The protected structure often has an additional coating of epoxy or plastic. The steel in the protected structure must be held to such an electrochemical potential that the steel enters the passive region and rusting cannot occur. If the structure is under protected, rusting will occur. If the structure is overprotected then hydrogen gas may be evolved from the steel, leading to embrittlement of the steel and delamination of the protective coating. The electrochemical potential is usually measured by a reference electrode with one end connected to the protected structure.

2. Determination of protection criteria.
Various methods are used to determine if the steel is suitably protected. Three common criteria are potential shift, on potential and rest potential.

(i) The potential shift measurement is carried out by switching off the rectifier and seeing the level of anodic shift (positive voltage movement) of the structure potential. Often a value of 100mV potential shift is used to determine if the structure is sufficiently protected.
(ii) On potential is measured when the rectifier is in operation. The potential then is taken as a measure of how far into passivity the steel is. A value of -1.4V against a Cu CuSO4 electrode is often taken as showing protection.
(iii) Off or rest potential is measured when the rectifier is switched off. Various methods are used to determine how quickly the potential falls to the rest potential and the slope of this depolarisation curve provides a measure of the protection.

These three protection criteria are based on different attributes and it is quite possible to have a structure with a 100mV potential shift, showing protection for criterion (i), not being in the passive region for on potential as shown in criterion (ii). There is not general agreement in the industry as to which protection criterion is best, but no one criterion is universal.

3. Fuzzy controller.
We propose that it is possible to make a controller that combines these three protection rules to make up a fuzzy control. The controller would determine how close to protection each of the criteria were and provide a linear dc output to our phase control system. The controller would also take other priority signals in, such as maximum voltage and current limits and recognise these as hard limits. The controller would interface with other parts of the rectifier so that off potential and potential shift can be measured by switching off the rectifier. The controller would also recognise when over protection was occurring. The weighting of each rule would be adjustable in software.

**Desirable Student Skills:**
Embedded systems, hardware & software development

Interest in practical applications control 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:**
Richard Brodribb
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Fax: + 61 3 9824 7372
www.brodribb.com.au

**Uni contact:**
Jim Whittington
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## Presentation of CAN Data for use in a supplementary receiving device (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.

Although the CAN data link layer is standardized, the fact that other protocol layers are left to the designers choice means that the transmitted data is invariably presented in a different fashion in each application.
Analysis of the data being generated for use in supplementary devices is therefore laborious as a consequence.

Howard Instruments is interested in supporting a project that analyses existing CAN data stream's and presents the information in a manner that can be used to program additional data receivers.

**Desirable Student Skills:**

- Appropriate understanding of CAN bus systems and data structure
- 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
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## Electronic ratio box
## (Industry Project)

**Sponsoring Company:**
Howard Instruments Pty. Ltd.

**Industry Supervisor:**
Ian Howard

**Summary:**
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.

This device is used in the automotive industry to change the calibration of electronic speedometers by changing the pulse frequency output by a pre determined ratio compared with the input pulse frequency. However, no ratio boxes on the market today can give a pure sine output. This ratio box should take the following inputs:-
(a) Sine wave with an amplitude ranging from 0.2 volts peak to peak to 30 volts peak to peak.
(b) Square wave from 4 volts to 30 volts with a 50% duty cycle.
(c) Standard vehicle's CAN bus and truck's J1939 CAN bus.

The ratio box should be able to produce ratios from 1.00 in to 3.00 out, through 1:1 to 3.00 in to 1.00 out.
The outputs should be:-
(a) Sine wave, variable between 10 & 30Vpp.
(b) Square wave, fixed 10V.
(c) Standard vehicle's CAN bus and truck's CAN bus.

A special feature of this ratio box is for the sine wave output to be a PURE sine wave. The means of ratio adjustment is negotiable.

**Desirable Student Skills:**
- Appropriate understanding of CAN bus systems and data structure
- 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:**
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03 94574755
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## 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 invoves 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.

**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:**
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**Uni contact:**
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## 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).

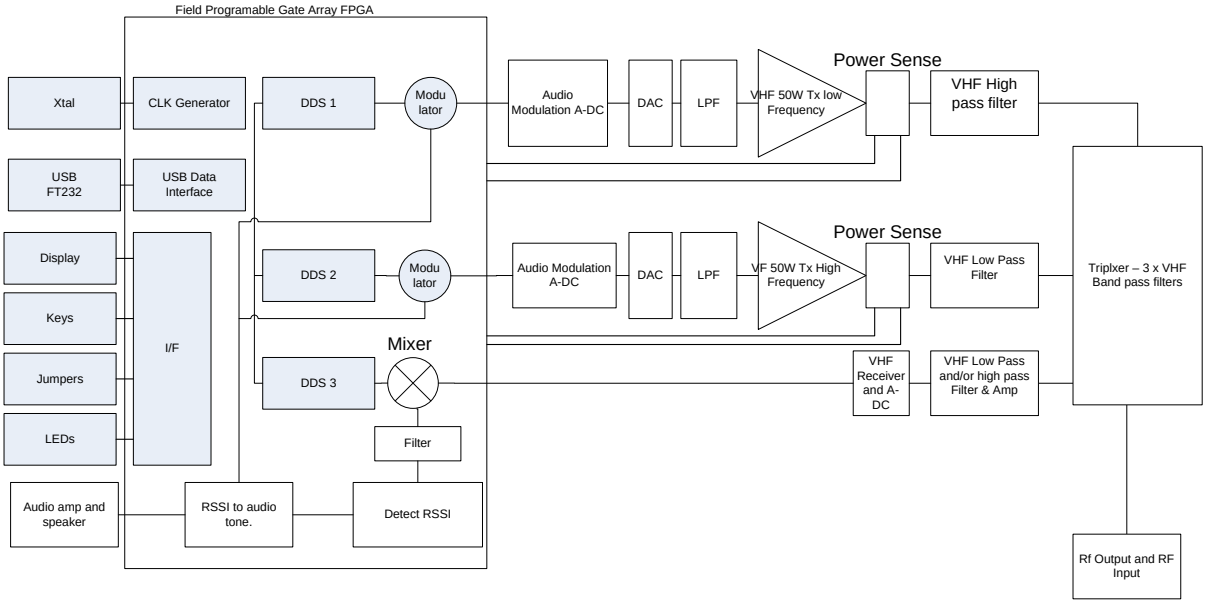
Appropriate RF filters will be selected to suit band width limitations and regulations on transmission.

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

# Smart Water Usage Management System with Persuasive Technology (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
Water conservation, along with increased recycling and boosting supplies, is a key part of the plan of the Federal Government of Australia to secure the country's water supplies. Given water is a very scarce resource, there is an increasing need for an improved method to manage and conserve water. One effective approach to conserve water is to have real-time information on water consumption available at consumers' end, through a smart water metering and water usage management system.

The aim of this research and development (R&D) project is to develop a consumer responsive and intelligent water usage management system, including the required hardware, networking and software as an integrated system. More specifically, the project will involve design and implementation in two key areas: (i) an intelligent low power chip (integrated circuit) for water metering, and (ii) an effective and secured networking method for monitoring and management of information related to water usage.

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 background communication and 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:**
Prof Jack Sigh or Dr Harris Le
Office: Centre for Technology Infusion; phone: 9479 3763
Email: Jack.Singh@latrobe.edu.au or h.le@latrobe.edu.au

## Design and implementation of an RF front-end for a WiMAX receiver
## (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
Worldwide Interoperability for Microwave Access (WiMAX) technology provides fixed, nomadic, portable and mobile wireless broadband connectivity. Theoretically, WiMAX can support data rate up to 70 Mb/s and maximum coverage of 50 km. To achieve the benefits of WiMAX systems, high performance RF transceiver is required and is one of the major challenges in WiMAX system implementation. There are typically two types of transceiver architectures used for WiMAX, namely low-IF and zero-IF architectures. A Low-IF architecture relieves the DC offset and flicker noise problems encountered in a zero-IF receiver, but it induces higher power consumption and cost due to the need of extra IF filter and down conversion of IF to DC. High level of integration and low power consumption suggest the zero-IF architecture as the best choice for WiMAX transceiver. In this architecture, the down conversion process is done using I/Q mixer, which is one of the most critical components. This project aim is to design and implement a low cost low power consumption RF front-end for a (fully on-chip) for a WiMAX receiver.

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.

**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:**
Prof Jack Sigh or Dr Harris Le
Office: Centre for Technology Infusion; phone: 9479 3763
Email: Jack.Singh@latrobe.edu.au or h.le@latrobe.edu.au

## Design and implementation of a baseband section of a WiMAX receiver
## (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
Worldwide Interoperability for Microwave Access (WiMAX) is increasingly gaining interests as an alternative "last-mile" technology to DSL lines and cable modems. This technology has the potential to support up to 70 Mbps of data per channel cell distance up to 50km. For WiMAX systems, its delay spread is typically over several micro-seconds which is easily longer than the guarding interval. It is very challenging to maintain the system BER performance for non-line-of-sight (NLOS) channels at high data rate transmission with high bandwidth. Therefore, the design of the baseband section is very important to ensure the proper system performance.

The scope of this project is to design and implement a baseband section of a WiMAX receiver on Application-Specific Integrated Circuit (ASIC). This project will investigate the possible implementation of the ASIC, the optimisation of the design, validation of the gate count, determination of power consumption, etc of the designed ASIC.

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 baseband design.

**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.

**Uni contacts:**
Prof Jack Sigh or Dr Harris Le
Office: Centre for Technology Infusion; phone: 9479 3763
Email: Jack.Singh@latrobe.edu.au or h.le@latrobe.edu.au

## Design and implementation of a receiver for a radio telescope application
## (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
Radio astronomy demands receiver systems of exquisite sensitivity to detect the faint signals emitted by distant astronomical objects. This sensitivity is achieved by building low-noise, low-power, broadband receivers. In order to achieve these specifications, the receiver systems will need to be built from highly-integrated components to convert the incoming signals from the universe and transfer it to digital systems for analysis. The scope of this project is to design and implement a low noise, low power, broadband receiver for radio telescope application. The big challenge is to overcome the inherent noise in an integrated circuit while achieving broad frequency band and high system gain.

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 background communication and electrical/electronic 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:**
Prof Jack Sigh or Dr Harris Le
Office: Centre for Technology Infusion; phone: 9479 3763
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# Design and implementation of a 2.4GHz transceiver (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
The current trend is moving toward wireless communication for home/consumer products due to the convenience and portability of wireless technologies. Some of the application includes consumer electronics, wireless game controllers, wireless audio, wireless keyboard and mouse, etc. All of these devices typically work in the 2.4GHz frequency band of, which falls under the license free ISM (industrial, scientific, and medical) band. Single chip low cost low power 2.4GHz RF transceiver is, therefore, important to efficiently enable the industrial and domestic wireless communication applications

The scope of this project is to design and implement a 2.4GHz transceiver, using 0.25-micron SOS technology. The transceiver will be direct conversion architecture, which has been proved to be the most suitable architecture for ISM wireless systems. This project will involve the design of both RF front end and digital backend, together with the design optimisation, validation and layout implementation. This project will provide invaluable design experiences for students perusing degrees in electronic. microelectronic and/or telecommunication engineering.

Up to ten (10) 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:**
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## Automatic Meter Reading Project
## (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
Current trend of energy management is changing toward real-time monitoring and control. There is an emerging trend to use powerline communication (PLC) technology to send and receive data over existing power lines, which is a very low cost solution for automatic meter reading (AMR) and advanced metering as no additional infrastructure is required for the data communication. With the increasing pressure on electricity utilities to reduce cost, provide excellent customer service and accurate billing, AMR has become an integral part of a strategic plan to offer better service and convenience while increasing the level of control and maintenance over the entire system. The aim of this project is to develop real-time AMR using PLC technology. Applications on automatic control and management of home appliances, lights will also be developed and tested in this project.

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 PLC, 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:**
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## Reliable and Secure Wireless Ad-Hoc Network for Vehicle-to-Vehicle Communication using DSRC
## (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
The emergence of the Dedicated Short Range Communications (DSRC) standard, that is a short to medium range wireless protocol specifically designed for automotive use, has paved the way to implement a wireless ad-hoc network for vehicles, which can be

used for communication among vehicles (vehicle-to-vehicle) and between vehicles and roadside equipments (vehicle-to-infrastructure). This, therefore, will facilitate the development of an intelligent network, which will provide solutions to improve vehicle safety, intelligence and efficiency. For example, vehicles will be able to "see" the traffic congestions, hazard of accidents (even out-of driver sight), produce less emission (more efficient on high way), encourage behavioural change (of drivers), etc. One of the major issues with the vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications is the reliability and security of such network, especially at high speeds. This project will involve the research into novel architectures, protocols and algorithms to increase the efficiency, reliability, security of the V2V/V2I communications.

Up to six (6) 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 communication and 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:**
Prof Jack Sigh or Dr Harris Le
Office: Centre for Technology Infusion; phone: 9479 3763
Email: Jack.Singh@latrobe.edu.au or h.le@latrobe.edu.au

## Wireless Technology for Reliable In-Vehicle Communication (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
The amount of in-vehicle electronic has increased significantly. Mature wireless technologies can be adapted for developing a wireless network that can link-up in-vehicle electronics and systems to offer a universal interface to all electronic devices while reducing the cabling required in the vehicle. Such wireless network will offer a greater flexibility and portability to car industry as well as improve safety, value to end-users and reduce cost. In order to achieve these benefits, in-car wireless network will need to be integrated to the current network. This research will access the potential of employing wireless technologies to in-car environment.

One of the major issues with the wireless in-vehicle network is reliability, security and the error rate of the wireless communication, due to ambient noise in the

automotive environment. Unexpected communication errors or device failure in receiving data can have major safety and implications especially when vehicles are travelling at high speeds.

Up to six (6) 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 communication and 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:**
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Email: Jack.Singh@latrobe.edu.au or h.le@latrobe.edu.au

## Design and implementation of an on-board unit (OBU) for vehicle communication based on DSRC standard (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
This project aims at the development of an on-board unit (OBU), both hardware and software, for the vehicle communication based on DSRC standard. The OBU will be implemented based on the integration of vehicle's electronic and sensor systems with multiple wireless technologies, including DSRC and GPS. Necessary interfaces between the vehicle's system, radio transceiver, application processors, sensors, human-machine interface (HMI), etc, will be developed to allow a seamless communication inside vehicle as well as outside vehicle (i.e. communication to infrastructure and other cars, trains, trams, truck). Necessary methodologies and algorithms will also be developed to effectively collect, manage and process data throughout the system. The data transmission across the wireless network will need to be very selective due to the high volume of data traffic. Interpretation, selective storage and analysis will be required to map raw data to knowledge useful to the cars, trains, etc. Comprehensive testing will be performed to ensure the proper functionality of the developed OBU.

Up to six (6) 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 digital design, receiver, communication system fundamentals and electrical/electronic 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:**
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## Design and implementation of a roadside unit (RSU) for vehicle communication based on DSRC standard (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
This project focuses on the development of a roadside unit (RSU), both hardware and software, based on integration of multiple technologies. Appropriate algorithms and interfaces will be developed to improve the performance of the RSU. The data transmission across the wireless network will need to be very selective due to the high volume of data traffic. Interpretation, selective storage and analysis will be required to map raw data to knowledge useful to the cars, trains, etc. The project will also focus on embedded design, software, data management and data security. Comprehensive verification will be performed to ensure the proper functionality of the developed RSU.

Up to six (6) 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 digital design, receiver, communication system fundamentals and electrical/electronic 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:**
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## Accurate Urban Navigation and Localisation System (Positioning & Tracking)
## (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications via dedicated-short-range-communication (DSRC) devices will enable active safety applications such as cooperative collision warning. However, a major challenge for the cooperative collision warning is to accurately determine the location of vehicles. The DSRC based V2V and V2I communication systems rely upon GPS (Global Positioning System) to co-ordinate for vehicle tracking and positioning. This technology, however, does not offer accuracy of the horizontal position error less than 1 meter, which is required for accurate vehicle localisation. In addition, currently available tracking algorithms are slow and require extensive computation to increase accuracy.

This project will focus on integration of various vehicle signals (like GPS, GSM, WiMax, WiFi, satellite, etc) to develop an accurate urban navigation and localisation (positioning & tracking) of vehicles. The proposed outcome is a fast, accurate and multi-stage feedback vehicle tracking and positioning algorithm with improved accuracy. Such a tracking system will improve the reliability of cooperative safety applications for vehicles.

Up to six (6) 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 communication and 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:**
Prof Jack Sigh or Dr Harris Le
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Email: Jack.Singh@latrobe.edu.au or h.le@latrobe.edu.au

## Integration of mature smart technologies to facilitate the development of a low cost fire management system (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
The research project will involve the integration of mature and smart technologies to facilitate the development of a low cost fire management system. This will include addressing the design and implementation issues of at the physical layer, including the integration and optimisation of existing technologies, such as smart sensor network, WAVE, GPS, smart suit, satellite, radio (wireless) architecture, and the development of necessary interfaces between the integrated technologies. A major concern is the cost and the reliability of such hardware platform. In order to address these issues, embedded intelligent properties will be developed to reduce the system complexity and cost while improving the system accuracy and reliability.

Up to six (6) 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 communication and 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:**
Prof Jack Sigh or Dr Harris Le
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Email: Jack.Singh@latrobe.edu.au or h.le@latrobe.edu.au

## Low cost intelligent traffic management network to improve emergency response time (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
An important application of the proposed cost effective fire management system based on the integration of smart technologies is the potential implementation of an intelligent traffic management network to improve response time to fire emergencies,

which will be developed in this research project. With this network, fire-trucks can wirelessly communicate with the roadway infrastructure (using WAVE technology), allowing complete, real-time traffic information for the entire network, as well as better traffic management and shortest route search for the emergency location. Fire emergency vehicles, equipped with longer range (1-kilometer) WAVE systems, will be able to warn vehicles ahead to let them pass and to control traffic lights to give them the right of way. GPS devices can be installed on fire-trucks and/or fire-fighter's smart suits to locate the exact location of the emergency team to efficiently guide them to the fastest possible direction to response to fire. Exactly identifying the location of fire-fighters and emergency vehicles will allow the fire management system to warn and prevent possible dangerous situations which can cause casualty for the emergency team. Sensors can be embedded on fire-fighters and fire-trucks to continuously monitor different environmental parameters such as temperature, oxygen levels, pressure level, wind velocity, vision, fire-fighter's wellbeing and appropriate decisions or responses can be made faster and more effectively. This intelligent traffic control network will not only reduce the response time to fire emergency situations but also significantly improve the efficiency and effectiveness of the fire management and the safety of the individuals.

Up to six (6) 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:**
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## Data management in the emergency management system (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof Jack Sigh & Dr Harris Le

**Abstract:**
Data management is a very important aspect in intelligent emergency response system, based on the integration of smart technologies. This is because the system, once in place, will receive large volume of data from sensors, camera, intelligent transport system, GPS, satellite, etc. This project will investigate and develop the necessary methodologies and algorithms to effectively collect data generated by the

devices inside the fire management system, as well as, manage and process data throughout the system. The data transmission across the wireless network should be very selective due to such high volume data traffic. Information/data, therefore, will need to be managed at both the device level and the system level. Interpretation, selective storage and analysis will then be required to map raw data to knowledge useful to the fire management system, which can then be reasoned with and acted upon. In order to accomplish this task, a hybrid data analysis and knowledge based technique will be developed to assign concepts to analysed raw data, using ontology of relevant concepts related to emergency situations of the environment.

Up to six (6) 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 communication and 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:**
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## Development of data collection system for ZigBee-based Wireless Sensor Networks (WSN) (Industry Project)

**Sponsoring Company:** Centre for Technology Infusion (CTI)

**Industry Supervisors:** Prof J. Sigh, Dr H. Le & A. Desai

**Abstract:**
This project will involve the development of a WSN hub board for Zigbee technology based WSNs. ZigBee is fairly limited by its data rate and communication distance, but offers very efficient low power of operation which is ideal for implementation of WSNs. To create the ability to merge and manage such network over long distances, a sensor hub will need to be designed. The hub will provide a bridge between ZigBee sensors over IP based communication using Wi-Fi and/or Ethernet. In addition to provide a communications bridge, this hub will also provide intermediate data storage and network configuration persistence information. The project involves development of the following:

- Hardware board Design and Implementation
- Sensor Profile/Configuration (Core Protocols) - Design and Implementation
- Data Collection Service and Synchronisation Policy Configuration

- Synchronise/Upload with parent WSN Node
- Sensor and Node Management Software for Implementation/Autoconfiguration of the Sensor Network.

Up to six (6) 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, PCB design, and programming.

**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:**
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## Investigation of Video Image Sharpening Techniques (Industry Project)

**Sponsoring Company:**
Blackmagic Design

**Industry Supervisor:**
David Stanhope,
Senior Hardware Engineer

**Abstract:**
Blackmagic Design is dedicated to allowing the highest quality video to be affordable to everyone, so the post production and television industry can become a truly creative industry. The company's products include video capture, monitoring, conversion and routing products.
Some of Blackmagic Design's products include video processing modules implemented in FPGAs and the goal of this project is to investigate techniques to "sharpen" video images and enhance the clarity of edges with a view to implementing those techniques within an FPGA.

Main Tasks:
- investigate video sharpening algorithms currently used by industry and academia
- make matlab model(s)
- participate in documenting functional specification
- learn the design environment used at Blackmagic Design.
- design, code (in VHDL) and simulate
- implement in the target FPGA / hardware and debug / test

**Required Student Skills:**
Good knowledge of DSP and digital design Basic knowledge of MATLAB FPGA design experience using VHDL Knowledge of Xilinx products/tool flow a bonus

**Company Support:**
Technical supervision
Xilinx FPGA target platform and hardware test environment

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

## Video Test Signal Generation and Automation (Industry Project)

**Sponsoring Company:**
Blackmagic Design

**Industry Supervisor:**
David Stanhope,
Senior Hardware Engineer

**Abstract:**
Blackmagic Design is dedicated to allowing the highest quality video to be affordable to everyone, so the post production and television industry can become a truly creative industry. The company's products include video capture, monitoring, conversion and routing products.
Blackmagic Design is interested in expanding its current FPGA video test signal generation capabilities, especially in the area of moving image tests and also exploring techniques of automating the testing of video products.

Main Tasks:
- explore issues in testing video
- learn the current design consisting mainly of video industry standard frame generation for different HD and SD formats with static pattern generation (eg colour bars), and learn the design environment.
- design the generator for new test pattern(s) and code it (VHDL)
- simulate the design, probably requiring test bench modifications.
- implement in target fpga / hardware and debug / test
- investigate feasibility and methods for automating the testing of video products

**Required Student Skills:**
Good knowledge of digital design
FPGA design experience using VHDL
Knowledge of Xilinx products/tool flow a bonus Knowledge of DSP a bonus (for example to evaluate the response of digital video filters to high frequency image test data)

**Company Support:**
Technical supervision
Xilinx FPGA target platform and hardware test environment

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

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## Wildlife Sanctuary Nursery Monitoring System (Industry Project)

**Sponsoring Company:**
LTU Wildlife Reserve

**Industry Supervisor:**
Andrew Stocker

**Abstract:**
The La Trobe Wildlife sanctuary consists of over 100 hectares of indigenous flora and fauna just positioned to the north of the La Trobe Bundoora campus. The retail nursery is responsible for maintaining floristic diversity in the region. This project will require students to build a microcontroller based monitoring system for the nurseries water management system.
Students will create a sensor system that detects certain conditions (eg. Moisture levels) and provides adequate water to maintain plant health. The system will also transmit information to the Nursery coordinator about plant/environmental conditions, including weather conditions (temperature/pressure) in addition to logging moisture content for different plants.

**Required Skills:**
Embedded C Programming Skills

**Area:** Embedded control systems/Communications Systems

**Uni Supervisor and contact:**
Robert Ross
Office: BG417
Email: r.ross@latrobe.edu.au

**Required Skills:**
Embedded C Programming Skills

**Area:** Embedded control systems/Communications Systems

**Uni Supervisor and contact:**
Robert Ross
Office: BG417
Email: r.ross@latrobe.edu.au

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## ECG based heart rate system with artefact rejection (Biomedical Industry Project)

**Sponsoring Company:**
Bionic Ear Institute

**Industry Supervisor:**
Dr. James Fallon

**Abstract:**
Heart rate is a vital indicator of health and anaesthetic status. While it is often possible to monitor heart rate using a pulse oximeter, there are many situations in which this is not practical. There is therefore a need for a simple electrocardiogram (ECG) based system. In experiments involving neural prostheses (i.e. bionic ears and bionic eyes), stimulus artefact, from the electrical stimulation of neural tissue, is often orders of magnitude large than the ECG signal, complicating the task of determining heart rate. You will design and construct a simple ECG based heart rate system that will be able to function in the presence of stimulus artefact from a neural prosthesis.

**Required Skills:**
Biomedical Engineering

**Uni Supervisor and contact:**
Graeme Rathbone
Office: PS2 117
Email: g.rathbone@latrobe.edu.au

## Biological Signal Conditioner (Biomedical Industry Project)

**Sponsoring Company:**
Bionic Ear Institute

**Industry Supervisor:**
Dr. James Fallon

**Abstract:**
Electrophysiological recordings are often contaminated by various forms of noise (including mains frequency noise and other biological signals). Experiments involving neural prostheses (i.e. bionic ears and bionic eyes) also need to contend with stimulus artefact, generated by the electrical stimulation of neural tissue. Therefore, biological signals need to be 'conditioned' before they can be recorded. You will design and construct a multi-stage signal conditioner to be used in electrophysiological experiments using neural prostheses. The conditioner will consist of amplification, artefact suppression and filtering stages, all of which will need to be adjustable. As the biological signals of interested are typically only a few microvolts in amplitude, the conditioner will also need to be electrically quiet.

**Required Skills:**
Biomedical Engineering

**Uni Supervisor and contact:**
Graeme Rathbone

Office: PS2 117
Email: g.rathbone@latrobe.edu.au

## iGuinea Pig
## (Biomedical Industry Project)

**Sponsoring Company:**
Bionic Ear Institute

**Industry Supervisor:**
Dr. James Fallon

**Abstract:**
Auditory brainstem responses (ABRs) and electrically evoked ABRs (EABRs) are measurements that are used for routine screening, as they can provide detailed information about the condition of the auditory pathway. The (E)ABRs signal is only a few microvolts in amplitude and therefore requires several stages of amplification and signal conditioning before it can be recorded. It is important that the recording equipment is fully operational and working correctly before it is used, therefore there is a need for a device that can be used as a model of the auditory pathway (the iGuinea Pig). You will design and construct a device that will respond to either an acoustic or electric stimuli with an (E)ABR like waveform that can then be used to test and validate the (E)ABR recording system.

**Required Skills:**
Biomedical Engineering

**Uni Supervisor and contact:**
Graeme Rathbone
Office: PS2 117
Email: g.rathbone@latrobe.edu.au

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# *ENGINEERING & RESEARCH PROJECTS*

## Remote Power Monitoring System for Green Power (Engineering Project)

**Abstract:**
This project will involve the design and construction of a remote monitor for a photovoltaic power system. The monitor will measure various parameters of the photovoltaic power system including, DC current, DC voltage, AC current, AC voltage and power factor. The sensors will be interfaced to an MSP430 microprocessor which will communicate the data to remote users via an ethernet connection.

**Required Student Skills:**
T.B.A

**Supervisor and contact:**
Peter Stewart
Office: BG435
Email: p.stewart@latrobe.edu.au

## WWLLN Lightning detector (Engineering Project)

**Abstract:**
This project will involve the construction and commissioning of a lightning detector. The detector will be integrated into the World Wide Lightning Location Network (WWLLN) which produces a global real time map of the location of lightning. The lightning detector is a simple VLF receiver and antenna connected to a linux computer which communicates individual lightning detections to central servers in New Zealand and the USA where the information from all detectors is used to determine the location of the lightning. The WWLLN provides a complete reference design. See http://webflash.ess.washington.edu/
for more details.

**Required Student Skills:**
T.B.A

**Supervisor and contact:**
Peter Stewart
Office: BG435
Email: p.stewart@latrobe.edu.au

## Near Space Sensor Package
## (Engineering Project)

**Abstract:**
On a daily basis, meteorologists routinely launch disposable radiosondes – small packages of embedded sensors which are carried by high altitude weather balloons. These packages typically have an array of sensors and a RF link which transmits sampled data back to a ground station.
The goal of this project is to create a reusable, recoverable radiosonde, which will reach an altitude in the order of 30km. Redundant communications interfaces will need to be designed and interfaced with a GPS and various atmospheric sensors (temp, pressure ect). The student will need to design their device to withstand cold temperatures (-45 degrees), a landing (parachute based) whilst devising hardware to capture data, photographs and video from altitudes up to 30km.

**Required Student Skills:**
Proficiency in embedded C programming
PCB design skills will prove valuable
Mechanical/ Physics background may assist – but is not mandatory

**Supervisor and contact:**
Peter Stewart
Office: BG435
Email: p.stewart@latrobe.edu.au

## Sports Radar
## (Engineering Project)

**Abstract:**
A miniature radar to measure the speed of cricket balls, tennis balls etc. The radar will be battery powered and based on a 10GHz doppler module and a low power Texas Instruments MSP microprocessor. Speed data will be communicated via a 2.4GHz radio link to a remote pc for processing, display and data logging.

**Required Student Skills:**
T.B.A

**Supervisor and contact:**
Peter Stewart
Office: BG435
Email: p.stewart@latrobe.edu.au

## Radar vehicle detector mote
## (Engineering Project)

**Abstract:**
A self-contained vehicle detector using microwave radar for sensing vehicle presence. The radar will be battery powered and will be installed on a road in the traffic lane. The sensor will produce an output when a vehicle is directly above it. Communication will be via 2.4GHz radio link. The detector will be controlled by a low power Texas Instruments MSP microprocessor.

**Required Student Skills:**
T.B.A

**Supervisor and contact:**
Peter Stewart
Office: BG435
Email: p.stewart@latrobe.edu.au

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## Train Velocity Control using Matlab
## (Research Project)

**Abstract:**
The aims of this project is 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

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## 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

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## Ask the Audience – Audience Response System
## (Engineering Project)

**Abstract:**
Researchers have noted lectures are good for disseminating information, but typically provide little feedback to the lecturer about how much students comprehend. In class multiple choice – hand raising quizzes can be inaccurate as students may decide to change their answers based on what other students are answering and not all students answer. Anonymous quizzes by data gathering devices are being introduced at some universities to get around this issue. This project will require students to design and build a 'Ask the Audience' style wireless voting system.
The student will design multiple choice remote controls (either IR or RF) and the system will collate student answers to questions and display them in real time on a graph. Students will need to account for sharing a common communications medium with many channels attempting to transfer information and will have to there develop algorithms allowing them share the medium.

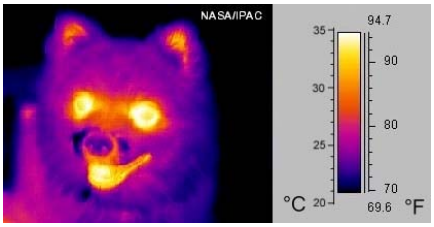
**Area:** Embedded control systems / Communications Systems

**Required Skills:**
Embedded C Programming Skills
Windows programming experience (eg. C# or Visual Basic)

**Supervisor and contact:**
Robert Ross
Office: BG417
Email: r.ross@latrobe.edu.au

## Thermographic range-finding camera
## (Engineering Project)

**Abstract:**
Thermal imaging cameras detect radiation in the IR range of the electromagnetic spectrum to produce thermograms, images mapping IR radiation. Thermal imaging cameras are typically very expensive. This project will require students to use a standard IR temperature sensor mounted on a (provided) stepper motor driven gimbal to create thermal image maps. A computer will be wirelessly used to drive the gamble and to construct the thermal image map.
In addition to thermal mapping, either ultrasonic sensors or stereoscopic vision will be used for range-finding to determine the distance way of objects under test – allowing a 3D thermal image map to be constructed.




**Required Skills:**
Embedded C Programming Skills
Windows programming experience (eg. C# or Visual Basic)

**Area:** Embedded control systems

**Supervisor and contact:**
Robert Ross
Office: BG417
Email: r.ross@latrobe.edu.au

## UAV – Automated Target Designator
## (Engineering Project)

**Abstract:**
The UAV Outback Rescue Challenge is an annual competition where competitors are required to drop a bottle of water to a lost person they locate in the middle of the desert (http://www.uavoutbackchallenge.com.au/uavoutbackchallenge/). On of the key challenge areas once the person is visually spotted is to provide an accurate determine of their location (long/lat) so that they can be verified as the target with the competition organisers and the water can be dropped.
This project will involve coupling GPS data (for current position), Gyro/Accelerometer data (for free space orientation), pressure data (for altitude) and data from a gimbal mounted camera to determine the location of an object of interest shown on the camera. Data will be transmitted over a long range radio link for further analysis on a computer.

Initial testing can be carried out from static locations (from the 4th level of BG building). With a fully operational design fitted to a real UAV for field tests.
A desirable extension would be automated control of dropping objects calculated to land at a specific (previously determined) location.

**Required Skills:**
Embedded C Programming Skills
Some mechanical aptitude
Basic windows programming experience (eg. C# or Visual Basic)
**Area:** Embedded control systems

**Supervisor and contact:**
Robert Ross
Office: BG417
Email: r.ross@latrobe.edu.au

## Robotic Rubik Cube Solver
## (Engineering Project)

**Abstract:**
The Rubik's cube is an iconic 3D mechanical puzzle which requires people to unscramble the colours. Rubik cubes can be simply solved by following a series of discrete algorithms.
The purpose of this project is to build a robot which will autonomously solve a cube, using colour recognition on a web camera to determine the colour positions and a series of actuators to manipulate the cube based on your calculated algorithms. A microcontroller will be interfaced to the computer where the algorithms can be executed.

**Required Skills:**
Embedded C Programming Skills
High mechanical aptitude
Basic windows programming experience (eg. C# or Visual Basic)

**Area:** Embedded control systems

**Supervisor and contact:**
Robert Ross
Office: BG417
Email: r.ross@latrobe.edu.au

## Universal IMU
## (Engineering Project)

**Abstract:**
Inertial Measurement Units (IMU) are devices which integrate gyroscopes and accelerometers to determine an objects velocity, position and pose using based on the accumulation of forces acting on an object.
The aim of this project is to create a universal IMU using a microcontroller and a series of MEMs accelerometers and gyroscopes along with a GPS to correct for long term drift.
In addition an SD card should be interfaced with the microcontroller to facilitate stand along operation with data logging. A USB interface should be provided to facilitate control and real-time data acquisition as well as to download previously stored data.
This project may find its way into UAVs, ground or even submersible robots.


**Required Skills:**
Embedded C Programming Skills
PCB Design Experience
Basic windows programming experience (eg. C# or Visual Basic)

**Area:** Embedded control systems

**Supervisor and contact:**
Robert Ross
Office: BG417
Email: r.ross@latrobe.edu.au

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## Autonomous Quadrotor Helicopter – Motor Control
## (Engineering Project)

**Abstract:**
In 2009 an Autonomous Quadrotor Helicopter was developed. To fly properly the Quadrotor Helicopter requires accurate control of movement in 6 degrees of freedom. In the 2009 project while basic flight was demonstrated, control of only 3 degrees of freedom was achieved. This project involves a redesign of the quad motor control system to achieve full fight control in 6 degrees of freedom. Some modelling of control system algorithms in Matlab may be required.

**Required Student Skills:**
- Control Systems
- Embedded Systems and ‘C’ programming.
- Matlab.

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

## Autonomous Quadrotor Helicopter – Vision System & Target Identification (Engineering Project)

**Abstract:**
In 2009 an Autonomous Quadrotor Helicopter was developed. A vision system for the Quadrotor Helicopter is required. As well as providing a video feed over a communications link, the vision system will contain image processing for pre-defined target identification (i.e. a landing pad). The vision system shall provide information to the flight control system, such that, accurate takeoff from, landing on and hovering over, a target can be achieved. It is expected the vision system will be developed on an FPGA platform. Some development and modelling of image processing algorithms in Matlab may be required.

**Required Student Skills:**

- FPGA design and testing with VHDL coding;
- Matlab.

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

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## Design and Evaluation of various alternative antenna and array structures for the TIGER radar (Research Project)

**Abstract:**
With the 3rd TIGER radar under construction a new double folded dipole antenna is replacing the old Sabre Log Periodic antenna. The research group is interested in investigating further optimisation of the current design as well as looking at alternative suitable antenna solutions adequate for the SuperDARN community. The student will utilise EZNEC antenna modelling software to design and configure various antennas and antenna arrays.

This project would be particularly suited to students in the Bachelor of Electronic Engineering/ Master of Telecommunication Engineering program.

More information on TIGER can be found at

http://www.tiger.latrobe.edu.au/

**Required Student Skills:**
. Skill coverage of one or more of the following will be essential.

- Antenna Theory
- Radio Frequency (RF) background

**Supervisor and contact:**
Eddie Custovic
Office: BG428
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## Design and Evaluation of Digital Transceiver Hardware for HF Radar System (Engineering Project)

**Abstract:**
The TIGER Radar research group is involved in the design, development, installation and use of HF radar systems. The Tiger group is interested in the design, evaluation and refinement of digital transceivers and/or sub blocks of digital transceivers for potential installation at one of its radar sites. Xilinx FPGAs are used as the digital hardware platform for implementation of the transceivers are Xilinx FPGAs.

This project will initially involve the evaluation of current digital transmitters and receivers through modelling and laboratory experimentation. Followed by an investigation of adaptations and refinements required to incorporate digital receivers into the current radar systems (hardware and software). Should the project progress well some studies in the field may be possible.

This project would be particularly suited to students in the Bachelor of Electronic Engineering/ Master of Telecommunication Engineering program.

**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;
- Good programming/debugging skills in Matlab and C/C++.

**Supervisor and contact:**
Jim Whittington
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