Department of Electrical and Computer Engineering
University of Windsor

Capstone Project Proposal (88-400)
Form 2: Proposal Form

This form is to show how you lay out the direction for your project. Please have a thorough research about your project and then fill out this form with consulting with your supervisor/co-supervisor. The form will be used as a part of the marking scheme in this course and is worth 10 points (out of 100).

After completion, email this form to the Capstone Design Project Coordinator Dr. B. Shahrrava at shahrrav@uwindsor.ca before the deadline (Monday Feb. 26th, at 4:00 pm).

Project Title:

Cardless Security System

Project Description:

Summary:

A cardless security system based on electrocardiogram (ECG) biometrics that will be able to identify an individual, assess their authorization privileges and subsequently permit or deny access to restricted areas. The entry regulation method will be a custom designed electronic door locking mechanism. Design is to include additional security features to prevent unauthorized entry. The unit itself will be battery operated with audio and visual indicators used to denote various system states.

Goals and Objectives:

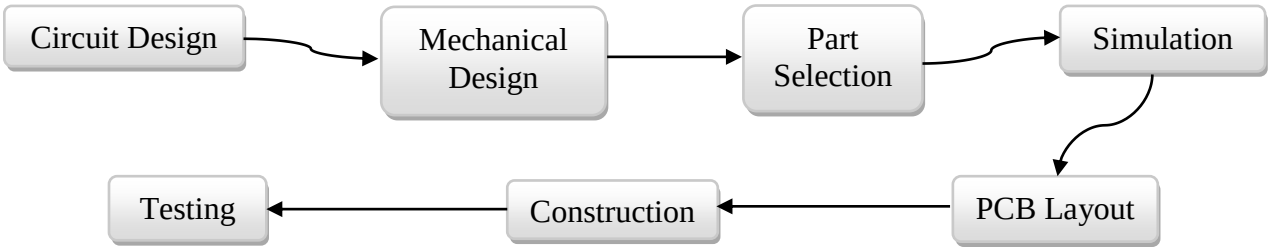
1) Differentiate between individuals based on personal ECG signals
2) A secure mechanical locking system driven by an electric motor

Brief background:

Most biometric identification devices currently in use throughout the world rely on either facial, fingerprint, retina, or voice recognition systems. All of these authentication methods have been shown to produce unique signatures that remain relatively consistent over time and are difficult to emulate with the notable exception of voice based systems. Although obviously less secure the appeal of audio biometric systems is driven primarily by its substantially lower implementation costs as opposed to the other metrics which require sophisticated vision hardware. This desire for inexpensive biometric devices has driven the search for alternative unique human signatures. Over the last few years electrocardiogram (ECG) based recognition has shown potential. One of the advantages of this metric include the fact it is an internal signal which is highly subject to personal health and mental state and is thus difficult to procure from unwilling or deceased individuals. It is also fairly inexpensive to both capture and process the ECG signals leading to a very high overall desirability. Research into this field is still being conducted and very few viable commercial products are currently available.

Methodology:

The selected project management methodology is the waterfall principle whereby tasks are performed in the sequential order which leads to the final product realization, taking into account prerequisites. The following diagram outlines the basic plan of attack with more detail provided in the attached Gantt chart.



Final Product/Result:

An enclosed printed circuit board mounted alongside a custom electronic door locking mechanism. The board is to include a built-in ECG acquisition system, audio and visual status indicators, as well as the internal processing power required to perform biometric identification.

Application of the End Result/Product:

Embedded electronic door lock security system with biometric ECG recognition capability.

Timeframe:

Approximate timetable information can be found on the attached Gantt Chart.

Students tasks:

Matthew Santos:
- Responsible for the development of the biometric algorithm
- Programing of the microprocessor including the design of all digital signal processing systems

Robert Goleberski:
- Design and implementation of the motor control system for the electromechanical lock
- Responsible for fulfilling all power electronics needs including the development of an onboard battery management system
- Production of several highly critical regulated supply lines with special consideration placed into ensuring user safety and device robustness

Zuwei Li:
- Complete design and implementation of the analog front end including all forms of user input
- Includes ECG and temperature sensor selection as well as a full sensor calibration assessment
- Design of highly precise analog amplifiers and filters with large emphasis placed on providing excellent ECG measurement by reducing noise from all sources including layout considerations

Project Budget:

Approximate Spending Budget
- $ 75 Micro processing unit including digital processing and other associated parts
- $100 Electromechanical systems and all power distribution components
- $100 Analog front end including all sensors and user control inputs
- $ 50 Printed circuit board manufacturing and miscellaneous expenditures

Total = $325 Value allows for reasonable design flexibility and includes a safety margin

Skill Requirements:

Minimum Required Skills:

- Understanding of electromechanical systems (88-313)
- Basic knowledge of embedded systems (88-327 and 88-443)
- Working understanding of analog amplifiers and filters (88-316)

Skills to Develop and Master:

- Printed circuit board design and layout
- Microprocessor programing
- Digital signal processing (88-457)
- Motor control system design
- Embedded power distribution and management (88-445)
- Analog sensor front end design with noise management

References:

The following is a list of relevant journal articles outlining both project applicability and methodology.

- I. Assadi, A. Charef, N. Belgacem, A. Nait-Ali, and T. Bensouici, "QRS complex based human identification," *2015 IEEE International Conference on Signal and Image Processing Applications (ICSIPA)*, 2015.
- A. Sarkar, A. L. Abbott, and Z. Doerzaph, "ECG biometric authentication using a dynamical model," *2015 IEEE 7th International Conference on Biometrics Theory, Applications and Systems (BTAS)*, 2015.
- S. Venugopalan, M. Savvides, M. O. Griofa, and K. Cohen, "Analysis of Low-Dimensional Radio-Frequency Impedance-Based Cardio-Synchronous Waveforms for Biometric Authentication," *IEEE Transactions on Biomedical Engineering*, vol. 61, no. 8, pp. 2324–2335, 2014.
- "Towards A Finger Based Ecg Biometric System," *Proceedings of the International Conference on Bio-inspired Systems and Signal Processing*, 2011.

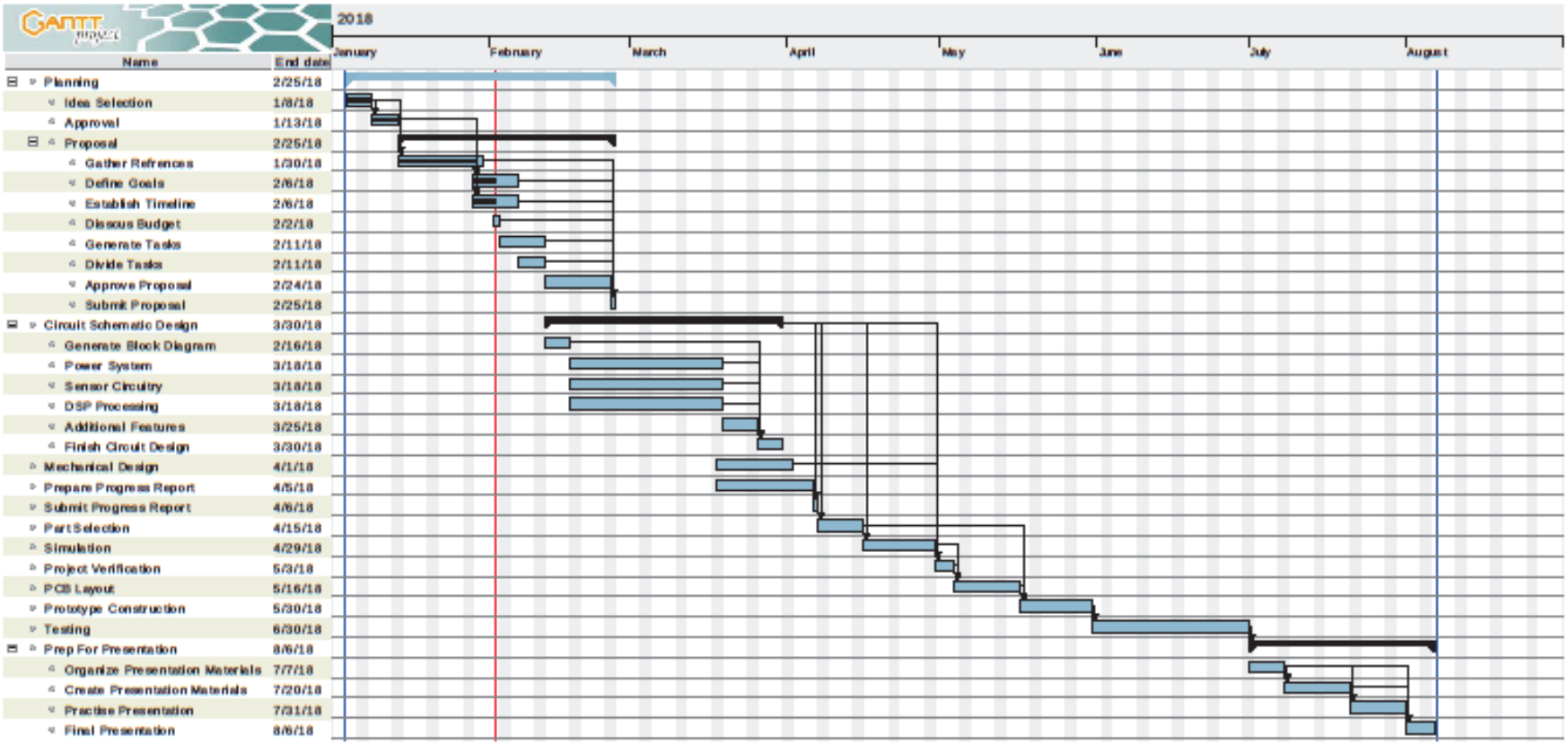
Group Members:

Student's Name	Student's ID#	Signature
Matthew Santos	103103503	
Robert Goleberski	104262016	
Zuwei Li	104165063	

Approved by the project supervisor and co-supervisor:

Name	Department	Signature
Dr. Emadi	ECE	
Dr. Mirhassani	ECE	

Gantt Chart


2018
January
February
March
April
May
June
July
August
Name
End date
Planning 2/25/18
Idea Selection 1/8/18
Approval 1/13/18
Proposal 2/25/18
Gather Refrences 1/30/18
Define Goals 2/6/18
Establish Timeline 2/6/18
Discuss Budget 2/2/18
Generate Tasks 2/11/18
Divide Tasks 2/11/18
Approve Proposal 2/24/18
Submit Proposal 2/25/18
Circuit Schematic Design 3/30/18
Generate Block Diagram 2/16/18
Power System 3/18/18
Sensor Circuitry 3/18/18
DSP Processing 3/18/18
Additional Features 3/25/18
Finish Circuit Design 3/30/18
Mechanical Design 4/1/18
Prepare Progress Report 4/5/18
Submit Progress Report 4/6/18
Part Selection 4/15/18
Simulation 4/29/18
Project Verification 5/3/18
PCB Layout 5/16/18
Prototype Construction 5/30/18
Testing 6/30/18
Prep For Presentation 8/6/18
Organize Presentation Materials 7/7/18
Create Presentation Materials 7/20/18
Practice Presentation 7/31/18
Final Presentation 8/6/18