DISCIPLINE OF ELECTRICAL AND COMPUTER ENGINEERING

FINAL YEAR PROJECT RISK ASSESSMENT

Rev. 0.6 21/02/2017

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

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Date:	2/8/2019

Final Year Project Details

Project Title:	**Brain Computer Interface Controlled 3D Printed Prosthetic Hand**
Brief Description:	The aim of this project is to design and construct a 3D printed prosthetic hand controlled by decoding neural activity. The device will amplify and filter real-time electroencephalography (EEG) data from an EEG cap, conduct a frequency analysis, then use classification techniques to determine the state of the wearer's hand (open or closed). This classification will be used to drive the servos in the prosthetic device. This will enable grasping of items such as umbrellas, water bottles, and cutlery, which would have a dramatic effect in the lives of people living with upper limb amputations, spinal cord injuries, or degenerative diseases

Before commencing your final year project you must complete a Lab Induction and an Access Quiz, regardless of where you will be working on your project.

The questions posed in this document are provided to help guide you through the Risk Assessment process. You should answer all the relevant questions in this document. Section 1 is only to be completed by students who are performing a final year project that involves completing some of the work at an Industry Sponsor's premises. Section 2 is to be completed by all final year project students.

Please complete the table below identifying any standard laboratory equipment that will be used to complete your project.

Standard Laboratory Equipment and Usage		
Soldering Iron	Used: ☑	Please ensure project participants are aware of potential safety hazards associated with soldering detailed on our Online Safety Manual (http://www.eng.newcastle.edu.au/eecs/ect/oh&s/Hazards/Soldering.html).
Heat Gun	Used: ☑	Please ensure project participants are aware of potential safety hazards associated with using a Heat Gun detailed on our Online Safety Manual (http://www.eng.newcastle.edu.au/eecs/ect/oh&s/Hazards/HeatGun.html).

Please list in the table below equipment that will be used to complete your project.

Equipment Description
3-D Prosthetic Hand and Forearm
Microcontroller
Amplifying and filtering circuits
Lab Bench Power Supply
Dry Electrode EEG Cap
Oscilloscope

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Section 1 Work to be performed at an Industry Sponsor's Premises

This section is only to be completed by students who will be completing some of their final year project work at their Industry Sponsor's Premises. If you are not performing any work at an Industry Sponsor's Premises go directly to Section 2.

1.1	Have you completed your Industry Sponsor's induction?	☐ Yes, go to 1.2	☐ No, go to 1.7
1.2	Have you been provided with training on equipment that you will be using?	☐ Yes, go to 1.3	☐ No, go to 1.7
1.3	Have you received instruction regarding your Industry Sponsor's Emergency policies, specifically the Evacuation procedure?	☐ Yes, go to 1.4	☐ No, go to 1.7
1.4	Have you been provided, or participated in, a Risk Assessment for your immediate workplace?	☐ Yes, go to 1.5	☐ No, go to 1.7
1.5	Attach a copy of the Risk Assessment to this document before submitting.		▪ go to 1.6
1.6	Do you have any concerns regarding your safety whilst working at your Industry Sponsor's premises?	☐ Yes, go to 17.	☐ No, proceed to section 2.
1.7.	Make an appointment with the Disciplines FYP Coordinator to discuss your Industry Sponsor's WHS polices to determine if they are acceptable to the University of Newcastle.		

Industry Supervisor			
Name:			
Signature:			
Phone:		Date:	
Academic Supervisor			
Signature:			
		Date:	

NB. signatures are only required here if work is to be performed at an Industry Sponsor's premises.

Section 2 Work to be performed at sites other than an Industry Sponsor's Premises, i.e. EE Laboratories, Home, etc.

This section is to be completed by all students. When completing this, students must consider all the places where they will be working on their final year project.

	General EE Safety Requirements The following questions have been included to ensure that you have complied with the Discipline's minimum WHS criteria. NB. 1. the Lab Induction is required as you will need, as a minimum, access to the labs to set-up and display your project on open day, and 2. successfully completing an Access Quiz gives us confidence that you are practically competent to work on your project without injuring yourself or other people.		
2.1	Have you completed the Discipline of Electrical and Computer Engineer's Lab Induction?	☑ Yes, go to 2.2	☐ No, then do it
2.2	Do you need unsupervised access to the Machines Lab (EEG06) in the EE Building?	☐ Yes, go to 2.3	☑ No, go to 2.4
2.3	Have you completed the Machines Lab Access Quiz?	☐ Yes, go to 2.5	☐ No, then do it
2.4	Have you completed the General Lab Access Quiz?	☑ Yes, go to 2.5	☐ No, then do it
2.5	Do you need unsupervised access to any of the EE Labs to complete your project?	☑ Yes, go to 2.6	☐ No, go to 2.7
2.6	Have you submitted your request for unsupervised access?	☑ Yes, go to 2.7	☐ No, then do it

	Electrical Hazards The following questions are meant purely as a guide. As this is a generic guide the questions cannot cover ever hazard that you may encounter during your project.		
2.7	Are you doing any hardware prototyping, i.e. building and testing and electronic circuit?	☑ Yes, go to 2.8	☐ No, go to 2.10
2.8	If you are using a mains powered Power Supply, are you protected by an RCD?	☑ Yes, go to 2.10	☐ No, go to 2.9
2.9	Document in the ***Additional Hazard Identification and Assessment*** section of this document the severity, likely hood and priority of this hazard and what controls you will implement to minimise the Risk.		▪ go to 2.10
2.10	Are you intending to use an Earth Isolated GPO's for any reason?	☐ Yes, go to 2.11	☑ No, go to 2.12
2.11	Document in the ***Additional Hazard Identification and Assessment*** section of this document the severity, likely hood and priority of this hazard and what controls you will implement to minimise the Risk.		▪ go to 2.12
2.12	Will you be working with any exposed conductors?	☐ Yes, go to 2.13	☑ No, go to 2.14

2.13	Document in the ***Additional Hazard Identification and Assessment*** section of this document the severity, likely hood and priority of this hazard and what controls you will implement to minimise the Risk.		▪ go to 2.14
2.14	Will you be working with any differential potentials greater than "extra low voltages" as prescribed in AS/NZS3000, i.e. $120V_{ac}$ and $50V_{DC}$?	☐ Yes, go to 2.15	☑ No, go to 2.16
2.15	To do this you will either need to have direct supervision or be given a specific induction by your academic supervisor. Document in the ***Additional Hazard Identification and Assessment*** section of this document how you will be working to minimise the Risk, including one of the options of direct supervision or a specific induction. NB. if you are provided with a specific induction, this induction must be fully documented and signed by your academic supervisor.		▪ go to 2.16
2.16	Does your project involve connecting any sensors to human body?	☑ Yes, go to 2.17	☐ No, go to 2.18
2.17	Connecting sensors to the human body, e.g. any electrically operated biomedical device, requires extreme care. As a minimum you should consult the Australian Standards AS/NZS 2500 and AS/NZS 3200.1.0:1998. You should document in the ***Additional Hazard Identification and Assessment*** section of this document the severity, likely hood and priority of any identified hazard and what controls you will implement to minimise the Risk. **NB. 1. never connect electrical sensors to the human body without first having your design and equipment configuration approved by your academic supervisor.** **2. before using another person as a subject in any testing you need to make sure you comply with the University's ethic's policy.**		▪ go to 2.18
2.18	Are there any other electrical hazards associated with your final year project?	☐ Yes, go to 2.19	☑ No, go to 2.20
2.19	Document each hazard you can identify in the ***Additional Hazard Identification and Assessment*** section of this document detailing the severity, likely hood and priority of each hazard and what controls you will implement to minimise the Risk of each one.		▪ go to 2.20

	Mechanical Hazards The following questions are meant purely as a guide. As this is a generic guide the questions cannot cover ever hazard that you may encounter during your project.		
2.20	Does your project involve Rotating Machinery?	☐ Yes, go to 2.21	☑ No, go to 2.22
2.21	Document in the ***Additional Hazard Identification and Assessment*** section of this document the severity, likely hood and priority of this hazard and what controls you will implement to minimise the Risk.		▪ go to 2.22
2.22	Does your project involve Moving Machinery?	☑ Yes, go to 2.23	☐ No, go to 2.24
2.23	Document in the ***Additional Hazard Identification and Assessment*** section of this document the severity, likely hood and priority of this hazard and what controls you will implement to minimise the Risk.		▪ go to 2.24
2.24	Does your project involve any Manual Handling?	☐ Yes, go to 2.25	☑ No, go to 2.26
2.25	Document in the ***Additional Hazard Identification and Assessment*** section of this document the severity, likely hood and priority of this hazard and what controls you will implement to minimise the Risk.		▪ go to 2.26
2.26	Are there any other mechanical hazards associated with your final year project?	☐ Yes, go to 2.27	☑ No, go to 2.28
2.27	Document each hazard you can identify in the ***Additional Hazard Identification and Assessment*** section of this document detailing the severity, likely hood and priority of each hazard and what controls you will implement to minimise the Risk of each one.		▪ go to 2.28

	Chemical Hazards The following questions are meant purely as a guide. As this is a generic guide the questions cannot cover ever hazard that you may encounter during your project.		
2.28	Are there any chemical hazards associated with your final year project?	☐ Yes, go to 2.29	☑ No, go to 2.30
2.29	Document each hazard you can identify in the ***Additional Hazard Identification and Assessment*** section of this document detailing the severity, likely hood and priority of each hazard and what controls you will implement to minimise the Risk of each one.		▪ go to 2.30

	Other Hazards		
2.30	Are there any other hazards that you have identified associated with your final year project?	☐ Yes, go to 2.31	☑ No, go to 2.32
2.31	Document each hazard you can identify in the ***Additional Hazard Identification and Assessment*** section of this document detailing the severity, likely hood and priority of each hazard and what controls you will implement to minimise the Risk of each one.		▪ go to 2.32

	Submission		
2.32	Fill in the details on the final page, get your academic supervisor to sign this document and submit this document to EE Technical staff in EEG07.	▪ Finished	▪ Finished

Section 2: Additional Hazard Identification and Assessment

How to Assess Risk

Step 1 – Consider the Consequences

What are the consequences of an incident occurring? Consider what could reasonably have happened as well as what actually happened.

Look at the descriptions and choose the most suitable Consequence.

CONSEQUENCE

Consequence	Personal Damage – Injury or illness
Serious	Extensive injury / permanently maimed or death
Major	Long term injury or illness
Medium	Medical Attention required with time off work (Lost Time Injury)
Minor	First Aid required / Hazard or Near Miss event would reported with follow up action
Insignificant	No injury or hazard or near miss requiring follow up

Step 2 – Consider the Likelihood

What is the likelihood of the consequence identified in step 1 happening? Consider this with the current controls in place.

Look at the descriptions and choose the most suitable Likelihood.

LIKELIHOOD

Likelihood	Description
Almost Certain	The event can be expected to occur in most circumstances (> 85 % chance of occurrence)
Likely	The event has a reasonable chance (> 50 %) of occurring (regularly) in usual conditions
Possible	The event might occur occasionally, has occurred sometime in past 10 years (20-49 % chance)
Unlikely	The event has a small chance of occurring (6-19%), but has occurred sometime in past 25 years
Rare	Exceptionally unlikely to occur < 5 % chance

Step 3 – Calculate the Risk

A. Take Step 1 rating and select the correct column.

B. Take Step 2 Rating and select the correct line.

C. The calculated risk score is where the two ratings cross

CONSEQUENCE	LIKELIHOOD: Rare	Unlikely	Possibly	Likely	Almost Certain
Serious	MED	MED	HIGH	EXTREME	EXTREME
Major	MED	MED	MEDIUM	HIGH	EXTREME
Medium	LOW	LOW	MEDIUM	MEDIUM	HIGH
Minor	LOW	LOW	LOW	MEDIUM	MEDIUM
Insignificant	Not applicable for health and safety risk assessment context				

- ”The magnitude of consequences of any event, should it occur, and the likelihood of the event and its associated consequences, are assessed in the context of the effectiveness of existing strategies and controls.” Section 3.4.3 AS/NZS 4360:2004, Risk Management.

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Controlling the Risk

Risk control is a method of managing the risk with the primary emphasis on controlling the hazards at source. For a risk that is assessed as "high", steps should be taken immediately to minimize risk of injury. The method of ensuring that risks are controlled effectively is by using the "hierarchy of controls". The Hierarchy of Controls are:

Order No.	Control Type	Example
Firstly	Eliminate	Removing the hazard, eg taking a hazardous piece of equipment out of service.
Secondly	Substitute	Replacing a hazardous substance or process with a less hazardous one, eg substituting a hazardous substance with a nonhazardous substance.
Thirdly	Isolation	Isolating the hazard from the person at risk, eg using a guard or barrier.
Fourthly	Engineering	Redesign a process or piece of equipment to make it less hazardous.
Fifthly	Administrative	Adopting safe work practices or providing appropriate training, instruction or information.
Sixthly	Personal Protective Equipment	The use of personal protective equipment could include using gloves, glasses, earmuffs, aprons, safety footwear, dust masks. **NOTE: This is a last resort control and should be for interim periods only, while higher level control is developed or implemented.**

What is a hazard?

A Could people be injured or made sick by things such as: • Noise • Light • Radiation • Toxicity • Infection • High or low temperatures • Electricity • Moving or falling things (or people) • Flammable or explosive materials • Things under tension or pressure (compressed gas or liquid; springs) • Any other energy sources or stresses • Biohazardous material • Laser	**B What could go wrong?** • What if equipment is misused? • What might people do that they shouldn't How could someone be killed? • How could people be injured? • What may make people ill? • Are there any special emergency procedures required? •
C Can workplace practices cause injury or sickness? • Are there heavy or awkward lifting jobs? • Can people work in a comfortable posture? • If the work is repetitive, can people take breaks? • Are people properly trained? • Do people follow correct work practices? • Are there adequate facilities for the work being performed? • Are universal safety precautions for biohazards followed? • Is there poor housekeeping? Look out for clutter • Torn or slippery flooring • Sharp objects sticking out • Obstacles	**D How might these injuries happen to people?** • Broken bones • Eye damage • Hearing problems • Strains or sprains • Cuts or abrasions • Bruises • Burns • Lung problems including inhalation injury/ infection • Skin contact • Poisoning • Needle-stick injury • •
E Imagine that a child was to enter your work area • What would you warn them to be extra careful of? • What would you do to reduce the harm to them?	**F What are the special hazards?** • What occurs only occasionally-for example during maintenance and other irregular work?

For more information visit - http://www.newcastle.edu.au/current-staff/working-here/work-health-and-safety/managing-health-and-safety-risks

Risk Assessment Matrix

Likelihood

Consequence

N.B. For more details regarding use of this matrix / definitions refer to final page of this document	Rare	Unlikely	Possible	Likely	Almost Certain
Severe *E.g. Extensive injury / permanently maimed or death*	MEDIUM	MEDIUM	HIGH	EXTREME	EXTREME
Major *E.g. Long term Injury or Illness*	MEDIUM	MEDIUM	MEDIUM	HIGH	EXTREME
Medium *E.g. Medical Attention required with time off work (Lost Time Injury)*	LOW	LOW	MEDIUM	MEDIUM	HIGH
Minor *E.g. First Aid required / Hazard or near miss reported with follow up action*	LOW	LOW	LOW	MEDIUM	MEDIUM
Insignificant *E.g. No injury or hazard or near miss requiring follow up*	Insignificant events not requiring follow up are not considered relevant within the context of a health and safety risk assessment framework: any health or safety risk is considered to have some significance.				

Summary of Requirements

Personal Protective Equipment (PPE)	Wear safety glasses when soldering or testing new circuits
Training	N/A
Equipment **(Standard Operating Procedures)**	Check design and equipment configuration with academic supervisor prior to connecting electrical sensors to the human body. Ensure fingers are clear of prosthetic device prior to operation. Ensure device is powered down before performing troubleshooting.
Relevant Legislation etc.	WHS Act 2011 (NSW) & Regulations e.g. A.S. / Codes of Practice Australian Standards AS/NZS 2500 and AS/NZS 3200.1.0:1998.
Review period/date	Review at start of Semester 1 2020, or as new hazards become apparent.

Actions required based on Risk Assessment

Extreme	An "extreme" risk requires immediate assessment and senior staff consideration is required; a detailed mitigation plan must be developed, and the activity should cease / not continue unless the risk can be reduced to a level of high or less; regular monitoring and reported on to the relevant management/steering committee; Target resolution should be within 3 - 6 months.
High	A "high" risk may also require immediate assessment and senior staff consideration; a mitigation plan must be developed; regular monitoring and reported on to the relevant management/steering committee. Target resolution (ideally reduction to medium or low level of risk) should be within 6 to 12 months.
Medium	A mitigation plan must be developed; existing controls, consequences and likelihood do not substantially change. Target resolution (ideally reduction to low level of risk) should be within 1 to 5 years.
Low	Risk is tolerable; manage by well established, routine processes/procedures and be mindful of changes to nature of risks.

Hazard Identification		Control		Risk Assessment
What are the steps of the activity / items of equipment?	**What are the potential hazards?**	**What methods will be used to reduce the likelihood and/or the consequence of an illness or injury from those hazards?**	**What hazard remains?**	**What is the level of risk remaining based on the Risk Assessment matrix?**
Soldering	Hot Soldering Iron, Molten Metal, Toxic Fumes	PPE → Wear eye protection when soldering Administrative → Ensure soldering is done in a well ventilated area, and contact is not made with hot iron.	None	Low
Prosthetic hand	Pinch point	Administrative → Ensure fingers remain clear of hand while in operation. Ensure device is powered off before commencing troubleshooting.	None	Low
Wearing EEG electrodes	Allergic reaction, electrical shock	Substitute → Use dry electrodes, rather than those requiring gel. Administrative → Check design and equipment configuration with academic supervisor prior to connecting electrical sensors to the human body. Ensure compliance with the University's ethics policy prior to using another person as a subject in any testing.	None	Low

Project Specific Training Requirements

Please ensure that any training that is required to participate in this project is detailed in the table below along with the date when that training expires:

Name	Low Voltage Rescue		Test before Touch		Laser Safety							
	Required (Y/N)	Expiry Date	Required (Y/N)	Expiry Date	Required (Y/N)	Expiry Date	Required (Y/N)	Expiry Date	Required (Y/N)	Expiry Date	Required (Y/N)	Expiry Date
Samuel Parker	N		N		N							

Students Name:	Samuel Parker		
Signature:			
Phone:	0421982410	Date:	2/8/2019
APPROVED BY:	Kaushik Mahata		
Academic Supervisor			
Signature:			
		Date:	