

Hello,

I am Ya Qi (Jerry) Liu requesting for Capstone Reimbursement on behalf of the following:

Ling Yin (Keith) Leung

Zhe-Hui (Jeffery) Yeung

Scott Checko

Ryne Watterson

Please find attached is a set of matching credit, bank, and PayPal statements for Capstone Reimbursement as well as a project and cost summary for ENSC 405W and ENSC 440 Capstone Reimbursement under Professor Andrew Rawicz. These statements should match the packet of receipts and invoices submitted to the ENSC office on December 13, 2019. All statements are named containing the purchaser and item number matching to list of items mentioned under cost summary, as well as to match the numbered sticky notes on each of the invoices and receipts.

Please Let me know if there are further information required.

Thank you,

Jerry Liu

ENSC 405W/440 Capstone Cost Summary – Team 5: TRIWAVE SYSTEMS

#	Item	From	Person	Date	Price
1	5 of: 1479-1002-1-ND DWM1000 RF TXRX MODULE 802.15.4 CHIP ANT	Digikey.ca	Jerry	11/06/2019	\$230.67
2	3 of: DWM1000 Loco Positioning deck SKU: 114990655 (**)	Bitcraze.io	Jerry	04/09/2019	\$395.67
3	1 of: Android Micro USB Cable	MINISO	Ryne	25/06/2019	\$6.67
4	1 of: 120pcs Multicolored Wire Kit 40pin Male to Female, 40pin Male to Male, 40pin Female to Female Breadboard Jumper Wires	Amazon.ca	Jeff	30/05/2019	10.99
5	12 of: 10uF Capacitors (1276-6456-1-ND) 24 of: 220 Ohm resistors (1276-3783-1-ND) 12 of: 10K Ohm resistors (1276-3670-1-ND) 25 of: Green LED (160-1446-1-ND)	Digikey.ca	Ryne	03/07/2019	\$17.22
6	3 of: ESP32-D0WDQ6 Development Board WiFi + Bluetooth	Amazon.ca	Jeff	04/06/2019	\$46.77
7	12 of: DecaWave DWM1000 Breakout-01 PCB boards (**)	oshpark.com	Jeff	26/06/2019	\$18.93
8	24 of: 220 ohm resistors (A130087CT-ND) 12 of: 10K ohm resistors (A102331CT-ND) 12 of: 10uF capacitors (1276-1119-1-ND) 1 of: Solder paste	Digikey.ca	Ryne	17/07/2019	\$46.23
9	1 of: Desolder Braid 1 of: Rosin Solder Flux	RP's Electronics	Ryne	07/08/2019	\$19.94
10	1 of: uxcell® DC3.7V 1000mAh Li-ion Rechargeable Battery	Amazon.ca	Jeff	14/08/2019	\$10.24
11	3 of: Topmate Power Bank Portable Charger 10000mAh	Amazon.ca	Jeff	06/09/2019	\$47.97
12	1 of: 5pcs Micro-USB 5V/1A TP4056 Li Battery Charger Module	Amazon.ca	Jeff	06/09/2019	\$8.99
13	5 of: 3.3V 8MHz ATmega328P-AU Pro Mini Microcontroller Board	Banggood.com	Jerry	11/09/2019	\$13.35
14	1 of: uxcell® 8x12cm Double Sided Universal PCB 3pcs 1 of: uxcell® 4x6cm Double Sided Universal PCB for DIY 5pcs	Amazon.ca	Keith	24/09/2019	\$17.49
15	1 of: Icstation AMS1117-3.3 DC Voltage Regulator Step Down Power Supply Module 4.75V-12V to 3.3V 800mA (Pack of 5)	Amazon.ca	Keith	24/09/2019	\$12.00
16	1 of: COVY CP2102 Module USB to TTL 5PIN Serial Converter Adapter Module, UART STC Downloader for 3.3V and 5V (2pcs)	Amazon.ca	Keith	03/10/2019	\$12.85
17	3 of: Slide Switch Mini On-On 30V 1 of: Battery, Rechargeable 4 of: Power Hexfet IRFZ44 N-Channel 4 of: Push Button PS-29C On-Off	Lee's Electronic	Keith	18/10/2019	\$38.98
18	2 of: Power Hexfet IRFZ44 N-Channel	Lee's Electronic	Keith	22/10/2019	\$5.60
19	1 of: 3D printed Prototype ID Tag casing + lid 1 of: 3D printed Prototype Beacon casing (**)	3D Hubs	Ryne	13/10/2019	\$73.67
20	10 of: 2-56x1-1/4 SOC HD cap 10 of: 2-56x1-1/4 HEX NUT	Pacific Fasteners Ltd	Jeff	12/11/2019	\$5.00
21	22 of: 2716 SCREWS 22 of: 2601 NUTS 44 of: 3206 Washers 1 of: Poppy Red spray paint 1 of: GLS White spray paint 1 of: 1/8-3/4 bolt screws	Home Depot	Keith	19/11/2019	\$42.69
22	1 of: 4/40-3/4 SCREWS 1 of: 4/40-3/4 NUTS	Home Depot	Keith	21/11/2019	\$6.66
23	1 of: PLA 3D Printer Filament 1.75mm +/- 0.02mm, 1 KG (2.2 LB)	Amazon.ca	Jeff	24/10/2019	\$31.44
24	1 of: 3D PLA-1KG1.75-WHT PLA 3D Printer Filament	Amazon.ca	Jeff	24/10/2019	\$29.89
Total [CAD]					\$1149.91

(**) Purchases were made in USD, price listed was converted to CAD using exchange rate on date of purchase

Capstone Project Summary: Akriveia B – Indoor Positioning System for Emergency Disaster Search and Rescue

The Akriveia Beacon focuses on locating personnel trapped in buildings during small scale disasters such as fires and low magnitude earthquakes. This is achieved by incorporating combinations of advanced Ultra-wide-band radio modules – DWM1000 modules from Decawave and Arduino Pro Mini combined with ESP32 microcontrollers to create a dependable indoor positioning system using trilateration.

The system is composed of Locator Beacons, an ID tags. Each Beacon contains a DWM1000 UWB module, Arduino Pro Mini, ESP32 Wi-Fi module, 10000 mAH rechargeable backup battery, MOSFET switches, and voltage regulators. Beacons are assembled on perfboards and encased in a custom designed 3D printed casing. Each ID tag contains a DWM1000 UWB module, Arduino Pro Mini, 1000 mAH rechargeable battery, and are also assembled on perfboards encased in a custom designed 3D printed casing.

USD to CAD Exchange Explanations

All purchase prices below are calculated using USD to CAD exchange rate of date of purchase.
Price points and exchange rates can also be seen on attached credit statements.

3 of: DWM1000 Loco Positioning deck SKU: 114990655

Purchased from: Bitcraze

Date: September 05, 2019

\$291.32 USD @ Exchange Rate 1.343607514 = **\$395.67 CAD**

1 of: 3D printed ID Tag casing

1 of: 3D printed beacon casing

Purchased from: 3D Hubs

Date: October 23, 2019

\$54.83 USD @ Exchange Rate 1.343607514 = **\$73.67 CAD**

12 of: DecaWave DWM1000 Breakout-01 PCB boards

Purchased from: OSH PARK

Date: June 26, 2019

\$14.00 USD @ Exchange Rate 1.35214 = **\$18.93 CAD**

Additional Notes:

1. **Item #6** was originally purchased in a set of 4 at the price of \$62.36 CAD (Under statement: **Jeff_CS_4_6**), 1 of the 4 item was returned due to being defective and \$15.59 CAD was returned (Under statement: **Jeff_CS_6_7**). The declared amount for 3 of the items is \$46.77.

2. **Item #24** was declared at \$29.89 CAD, however, under credit statement **Jeff_CS_23_24** listed under **Amazon.ca *SH1E85XZ3 AMAZON.CA** the item was charged \$33.48 CAD, because the declared price did not reflect price of GST/HST and PST/RST/QST. Please only consider the declared amount of \$29.89 CAD for reimbursement.

3. **Item #20** Was purchased in **cash** from Pacific Fasteners Ltd

4. **Item #13** was purchased along with other items which are not declared for reimbursement. Total cost was \$29.22 CAD (Under Statement **Jerry_CS_13**) but the item declared was only \$13.35.

Project Component Purpose Summary

#	Item	Purpose
1	5 of: 1479-1002-1-ND DWM1000 RF TXRX MODULE 802.15.4 CHIP ANT	UWB transceiver Modules used for ranging in indoor tracking system, on tracking beacons and tracker tags and for UWB ranging testing
2	3 of: DWM1000 Loco Positioning deck SKU: 114990655 (**)	UWB transceiver Modules used for ranging in indoor tracking system, on tracking beacons and tracker tags and for UWB ranging testing
3	1 of: Android Micro USB Cable	Powering and charging Beacon hardware battery devices
4	1 of: 120pcs Multicolored Wire Kit 40pin Male to Female, 40pin Male to Male, 40pin Female to Female Breadboard Jumper Wires	Proof of concept prototype testing, and various electrical testing before final assembly of hardware components
5	12 of: 10uF Capacitors (1276-6456-1-ND) 24 of: 220 Ohm resistors (1276-3783-1-ND) 12 of: 10K Ohm resistors (1276-3670-1-ND) 25 of: Green LED (160-1446-1-ND)	PCB Components for UWB transceiver modules Voltage damping capacitors And RX/TX led with current limiting resistors Soldered onto PCB ordered from OSH PARK
6	3 of: ESP32-D0WDQ6 Development Board WiFi + Bluetooth	Wi-Fi MCU component for anchor beacons to communicate with server
7	12 of: DecaWave DWM1000 Breakout-01 PCB boards (**)	PCB breakout board for mounting UWB modules
8	24 of: 220 ohm resistors (A130087CT-ND) 12 of: 10K ohm resistors (A102331CT-ND) 12 of: 10uF capacitors (1276-1119-1-ND) 1 of: Solder paste	PCB Components for UWB transceiver modules Voltage damping capacitors UWB modules - IRQ to ground resistors Solder for soldering components onto PCB ordered from OSH PARK
9	1 of: Desolder Braid 1 of: Rosin Solder Flux	For assembling PCB components and final hardware assembly
10	1 of: uxcell® DC3.7V 1000mAh Li-ion Rechargeable Battery	Rechargeable Lithium ion Battery for ID Tag
11	3 of: Topmate Power Bank Portable Charger 10000mAh	Rechargeable Lithium ion backup Battery for Beacons
12	1 of: 5pcs Micro-USB 5V/1A TP4056 Li Battery Charger Module	Charging modules for beacon and tag battery
13	5 of: 3.3V 8MHz ATmega328P-AU Pro Mini Microcontroller Board	Main Micro-controller units for beacons and tags
14	1 of: uxcell® 8x12cm Double Sided Universal PCB 3pcs 1 of: uxcell® 4x6cm Double Sided Universal PCB for DIY 5pcs	For holding hardware and electronic circuit components on beacons and ID tags, used for final assembly
15	1 of: Icstation AMS1117-3.3 DC Voltage Regulator Step Down Power Supply Module 4.75V-12V to 3.3V 800mA (Pack of 5)	Regulating voltage levels on beacons, 5V (for esp32-Wi-Fi) down to 3.3V (for Arduino and DWM1000) on beacons
16	1 of: COVY CP2102 Module USB to TTL 5PIN Serial Converter Adapter Module, UART STC Downloader for 3.3V and 5V (2pcs)	TTL programmer for tag and beacon microcontroller Arduino Mini Pro 3V 8Mhz
17	3 of: Slide Switch Mini On-On 30V 1 of: Battery, Rechargeable 4 of: Power Hexfet IRFZ44 N-Channel 4 of: Push Button PS-29C On-Off	Switches for turning beacons and tags on/off, Additional Batteries for id tag, MOSFET for logic level shifting on beacon to trigger MOSFET switch, and MOSFET voltage switch for powering on/off the Arduino
18	2 of: Power Hexfet IRFZ44 N-Channel	For logic level shifter and MOSFET voltage switch
19	1 of: 3D printed Prototype ID Tag casing+ lid 1 of: 3D printed Prototype Beacon casing (**)	Prototype design 3D printed casing for beacon and id tag, was printed too big and was reprinted later
20	10 of: 2-56x1-1/4 SOC HD cap 10 of: 2-56x1-1/4 HEX NUT	For bolting the base casing and lid cover on id tag for final assembly
21	22 of: 2716 SCREWS 22 of: 2601 NUTS 44 of: 3206 Washers 1 of: Poppy Red spray paint 1 of: GLS White spray paint 1 of: 1/8-3/4 bolt screws	For final Product assembly, Bolting steel elbow bars together to make tall tripods for beacons used during demo, Paint for coloring 3D printed beacon and ID tag casing, Screws for mounting Beacon PCB perfboard to the 3D printed casing and for mounting the beacons onto tripod
22	1 of: 4/40-3/4 SCREWS 1 of: 4/40-3/4 NUTS	Screws for mounting Beacon PCB perfboard to the 3D printed casing and for mounting the beacons onto tripod
23	1 of: PLA 3D Printer Filament 1.75mm +/- 0.02mm, 1 KG (2.2 LB)	Final 3D printing for beacon + ID tag casing material and multiple prints
24	1 of: 3D PLA-1KG1.75-WHT PLA 3D Printer Filament	Final 3D printing for beacon + ID tag casing material and multiple prints