Air Mouse Project Summary:

Electronic devices such as laptops, computers and smartphones take user input in various forms. The conventional 2D mouse is one of the most commonly used aids for this. With Air Mouse, the team plans to devise an innovative way to control mouse movements wirelessly to enhance the user experience of interacting with technology. The basic idea of an Air Mouse is a wearable glove technology that takes hand movements and gestures in air and converts them into 2D mouse movements.

The Air Mouse development can be broken down into two major categories: hardware design and software programming. At the heart of the project lies the nRF52 microcontroller which houses the Bluetooth LE Raytac module. Bluetooth LE is the device communication protocol used for this project. This microcontroller is mounted on a cotton glove that is worn by the user. The hardware system comprises mainly of the microcontroller, flex sensors, battery, NeoPixel, pressure sensitive sheets, laser diode and a vibration motor. The components of the Air Mouse were individually tested on a breadboard and eventually integrated onto a cotton, right-hand glove to produce the final prototype.

The functions required of the Air Mouse can be broadly classified into states such as scrolling, left click, right click and cursor movements. Hence, a finite state machine model was implemented using the input from the flex sensors placed on the fingers of the glove, barring the thumb. The Air Mouse is powered by a rechargeable battery and NeoPixels, which are smart LEDs, were programmed to display the battery state of charge to the user through an arbitrarily developed color code scheme. The Universal Windows Platform Application was programmed in relation to GATT services to mimic and display the rotational and spatial movements of the glove in 3D space. The application also allows the user to read the remaining percentage of battery life directly from it.

This project can be deemed a success as it was able to meet all the proposed specifications. The final prototype can perform all basic mouse functions such as scrolling, left and right clicks, hold and drag items where applicable, like a conventional mouse. A small vibration motor between the index and middle fingers provides the user with haptic feedback upon a successful clicking action. The battery is able to support the Air Mouse operations for 2 hours and 20 minutes which is higher than the proposed requirement of 2 hours. In line with the proposal, Air Mouse also comes equipped with a laser diode to aid in presentations with a pressure sensitive control. The glove fabric along with the careful selection and placing of components also ensures that it is light and ergonomically designed for user convenience.

Summary of Performance Metrics:

The design proposed design specifications and final performance metrics are summarized in the table below:

ID	FEATURE	RANGE	COMPLETED
1	All components must fit on all standard glove sizes (XS-XL)	Yes/No	Yes
2	Design is able to send/receive information using the Bluetooth LE standard	Yes/No	Yes (nRF52 Bluetooth Module)
3	Design can move mouse cursor on a computer using hand movements	Yes/No	Yes (controlled by BNO055) *Pointing Mode Precision* Horizontal: 29 pixels/degree Vertical: 16 pixels/degree *Moving Mode Precision* Both: 114 pixels/(degree*second)
4	Design can perform mouse clicks on a computer using hand movements	Yes/No	Yes (Left and Right Click triggered by Flex)
5	Design can scroll/pan on a computer using hand movements	Yes/No	Yes (controlled by BNO055)
6	Design is able to be used in a 3D axis application	Yes/No	Yes (Windows 10 Application)
7	Design is powered by a portable power source	Yes/No	Yes (3.7V 110mAh LiPo battery)
8	User is able to turn on/off device to reduce power consumption	Yes/No	Yes (Switch)
9	Battery Life Specifications	> 2 hours	Yes (2h 20m)
10	Battery State of Charge Indicator	Percentage, or Segments/Low Warning	Yes (Green, Yellow, Red, with varying brightness)
11	Haptic feedback on mouse clicks	Yes/No	Yes (3V motor)
12	Hand gestures to enable laser pointer aid for presentations	Yes/No	Yes (triggered by pressure sheets)

Budget and Resources

The team budget remained close to the proposed values with minor changes as outlined below:

Item	Vendor	URL (if available)	Price (CAD)	Proposed Qty	Finall Qty
FEATHER NRF52 BLUEFRUIT LE	Digikey Canada	https://www.digikey.ca/products/en?mpart=3406&v=1528	$33.72	2	3
USB 2.0 A MALE TO USB 2.0 MICRO	Digikey Canada	https://www.digikey.ca/product-detail/en/qualtek/3025030-03/Q966-ND/6188812	$5.23	3	3
THREAD 316L THIN COND 3PLY 60'	Digikey Canada	https://www.digikey.ca/product-detail/en/adafruit-industries-llc/641/1528-1268-ND/5356753	$10.00	1	1
CONN HEADER .100" SNGL STR 40POS	Digikey Canada	https://www.digikey.ca/products/en?mpart=PRPC040SFAN-RC&v=35	$1.14	2	2
CONN HEADER .100" SNGL R/A 40POS	Digikey Canada	https://www.digikey.ca/products/en?mpart=PRPC040SBAN-M71RC&v=35	$1.24	2	2
FLORA ACCEL/GYRO/MAGN 9-DOF	Digikey Canada	https://www.digikey.ca/product-detail/en/adafruit-industries-llc/2020/1528-1335-ND/5356820	$26.96	1	1
LiPo Battery Cell - 3.7V 110mAh	Robotshop Canada	http://www.robotshop.com/ca/en/lipo-battery-cell-37v-110mah.html	$6.35	1	1
Pressure-Sensitive Conductive Sheet	Robotshop Canada	http://www.robotshop.com/ca/en/pressure-sensitive-conductive-sheet-velostat-linqstat.html	$5.06	1	1
FLORA PLATFORM RGB NEOPXL V2 4PK	Digikey Canada	https://www.digikey.ca/product-detail/en/adafruit-industries-llc/1260/1528-1310-ND/5356795	$10.74	1	1
Woven Silver Conductive Fabric 400cm²	Robotshop Canada	http://www.robotshop.com/ca/en/woven-silver-conductive-fabric-400cm.html	$6.35	1	1
MOD FLORA WEARABLE BLUEFRUIT LE	Digikey Canada	https://www.digikey.ca/products/en?mpart=2487&v=1528	$23.65	1	1
FLORA ELECTRONIC PLATFORM V2	Digikey Canada	https://www.digikey.ca/products/en?mpart=659&v=1528	$20.21	1	1
LEAD SET 10 MINI-ALLIGATOR 22AWG	Digikey Canada	https://www.digikey.ca/products/en?mpart=BU-00285&v=314	$9.41	2	2
SWITCH SLIDE SPDT 300MA 6V	Digikey Canada	https://www.digikey.ca/product-detail/en/apem-inc/MHSS1105/679-1849-ND/1949465	$0.73	5	5

VIBRATION MOTOR 3VDC	Digikey Canada	https://www.digikey.ca/products/en?mpart=316040001&v=1597	$1.76	1	1
BREADBOARD PERMA-PROTO PCB SGL	Digikey Canada	https://www.digikey.ca/product-detail/en/adafruit-industries-llc/1606/1528-1100-ND/5154675	$9.39	1	1
JUMPER WIRE M/M 40X6" 150MM	Digikey Canada	https://www.digikey.ca/product-detail/en/adafruit-industries-llc/758/1528-1154-ND/5353614	$5.34	1	1
FEMALE/FEMALE JUMPER WIRES 40X6	Digikey Canada	https://www.digikey.ca/product-detail/en/adafruit-industries-llc/266/1528-1379-ND/5629427	$5.34	1	1
JUMPER WIRE F/M 40X6" 150MM	Digikey Canada	https://www.digikey.ca/product-detail/en/adafruit-industries-llc/826/1528-1162-ND/5353622	$5.34	1	1
LASER DIODE - 5MW 650NM RED	Digikey Canada	https://www.digikey.ca/product-detail/en/adafruit-industries-llc/1054/1528-1391-ND/5629439	$8.04	1	1
ANALOG 2-AXIS THUMB JOYSTICK WIT	Digikey Canada	https://www.digikey.ca/products/en?mpart=512&v=1528	$8.56	1	1
2.2" 10K Flexible Sensor	Robotshop Canada	http://www.robotshop.com/ca/en/22-10k-flexible-sensor.html	$9.99	10	1
BNO055 9 DOF Absolute Orientation IMU Fusion Breakout Board	Robotshop Canada	http://www.robotshop.com/ca/en/bno055-9-dof-absolute-orientation-imu-fusion-breakout-board.html	$44.81	1	1
3M 35-WHITE-1/2 Electrical Tape	Digikey Canada	https://www.digikey.ca/product-detail/en/3m/35-WHITE-1-2/3M15557-ND/1818756	$3.60	1	1
Cotton Glove	Peavey Mart		$15.00		1

Budget (CAD)	$600.00
Total Proposed	$421.76
Total Spent (CAD)	$470.48