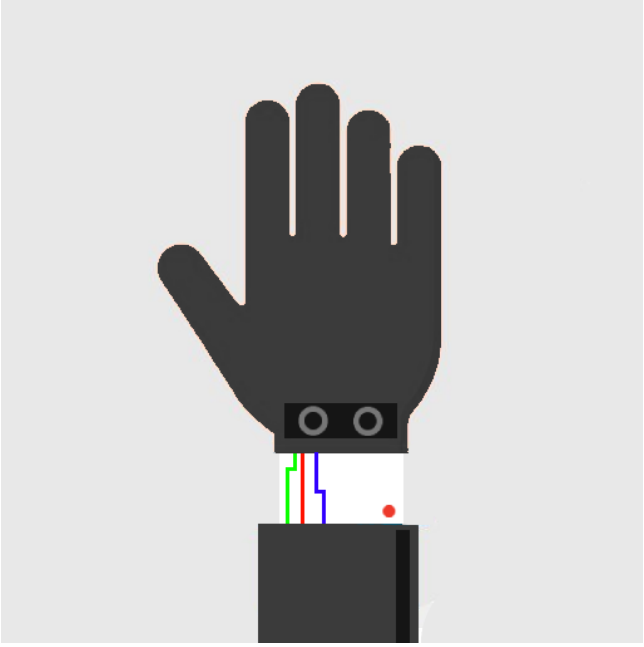

Project Documentation
Smart Prosthetic Arm
Hybrid Prosthetics™

Prepared for:
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CENG 322 - CENG 317

Prepared by:
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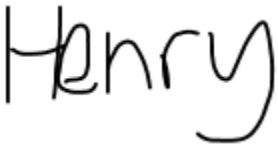
Team Contract

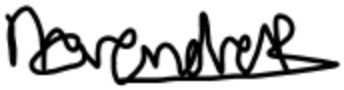
Team Name: Hybrid Prosthetics

Project Name: Smart Prosthetic Arm

Please note that if cheating is discovered in a group assignment each member will be charged with a cheating offense regardless of their involvement in the offense. Each member will receive the appropriate sanction based on their individual academic honesty history.

Please ensure that you understand the importance of academic honesty. Each member of the group is responsible to ensure the academic integrity of all of the submitted work, not just their own part. Placing your name on a submission indicates that you take responsibility for its content.

Team Member Names (Please Print)	Signatures	Student ID
Project Leader: Samad Agha		N01364908
Kevin Santizo		N01382533
Henry To		N01365792

Narendre Ramdhan		N01240746

For further information read Academic Honesty Policy on https://humber.ca/legal-and-risk-management/policies/search-by-students.html.

By signing this contract, we acknowledge having read the Humber Academic Honesty Policy as per the link below.

https://academic-regulations.humber.ca/2018-2019/17.0-ACADEMIC-MISCONDUCT

Responsibilities of the Project Leader include:

- Assigning tasks to other team members, including self, in a fair and equitable manner.
- Ensuring work is completed with accuracy, completeness and timeliness.
- Planning for task completion to ensure timelines are met
- Any other duties as deemed necessary for project completion

What we will do if . . .

Scenario	**Accepted initials**	**We agree to do the following**
Team member does not deliver component on time due to severe illness or extreme personal problem	SA HT K.S NR	a) Team absorbs workload temporarily _X_ b) Team seeks advice from professor __

		c) Team shifts target date if possible __ d) Other:
Team member cannot deliver component on time due to lack of ability	SA HT K.S NR	a) Team reassigns component __ b) Team helps member _X_ c) Team member must ask professor for reference material __ d) Other:
Team member does not deliver component on time due to lack of effort	SA HT K.S NR	a) Team absorbs workload _X_ b) Team "fires" team member by not permitting his/her name on submission __ c) Other:

Team member does not attend team meeting	SA HT K.S NR	a) Team proceeds without him/her and will assign work to the absent member _X_ b) Team doesn't proceed and records team member's absence __ c) Team proceeds for that meeting but "fires" member after __ occurrences __
An unforeseen constraint occurs after the deliverable has been allocated and scheduled (a surprise test or assignment)	SA HT K.S NR	a) Team meets and reschedules deliverable _X_ b) Team will cope with constraint __ c) Other:
Team cannot achieve consensus leaving one member feeling "railroaded", "ignored", or "frustrated" with a decision which affects all parties	SA HT K.S NR	a) Team agrees to abide by majority vote _X_ b) Team flips coin __ c) Other:

Team members do not share expectations for grade desired	SA HT K.S NR	a) Team will elect one person as "standards-bearer" who has the right to ask that work be redone _X_ b) Team votes on each submission's quality __ c) Team will ask for individual marking and will identify sections by author __ d) Other:
Team member behaves in an unprofessional manner by being rude or uncooperative	SA HT K.S NR	a) Team attempts to resolve the issue by airing the problem at team meeting _X_ b) Team requests meeting with professor to problem-solve __ c) Team ignores behaviour __ d) Team agrees to avoid use of all vocabulary inappropriate to the business setting __

Team member assumes or requests that his/her name be signed to a submission but has not participated in production of the deliverable	SA HT K.S NR	a) Team agrees that this is cheating and is unethical _X_ b) Friends are friends and should help each other __ c) Team will submit with signature but will advise professor who will take action __
There is a dominant team member who is content to make all decisions on the team's behalf leaving some team members feeling like subordinates rather than equal members	SA HT K.S NR	a) Team will actively solicit consensus on all decisions which affect project direction by asking for each member's decision and vote _X_ b) Team will express subordination feelings and attempt to resolve issue __ c) Other:

Team has a member who refuses to participate in decision making but complains to others that s/he wasn't consulted	SA HT K.S NR	a) Team forces decision sharing by routinely voting on all issues _X_ b) Team routinely checks with each other about perceived roles __ c) Team discusses the matter at team meeting __

Executive Summary

Project:

Prosthetic Arm

Description

The focus of this project is a synthetic arm meant to benefit disabled individuals. This arm will have many functions, including temperature measurement, object detection, rotational axes (servos) and supports bluetooth/wireless connection. These functionalities will all be displayed to an app for the user to get all the information necessary to help with their everyday lives. With the temperature sensor, it can relay information to the app on whether the object it's holding is “hot” or “cold” (such as a cup of coffee) depending on the range given. With the Ultrasonic object sensor, the hand will be able to grasp on to an object after sensing it. The arm will be able to rotate and move fingers from servos, these servos also communicate with the Ultrasonic sensor. The app will be notified that “An object is in range” of its palm. The arm will be 3D printed, and designed for the sensors to work with it. The mobile application developed on android studio will require logging in before being able to use it and will have an option to register if no account has been created. For credentials and data Google Firebase will be used. All this data will be The application will be available on the Google Play Store. In addition with sensor and servo information given to the application, the user will be able to manually control the arm through bluetooth/wireless connection. A button on the app will control the servo to open or close its hand (High torque servo required for better grip). A blueprint for hardware will be designed along with a test PCB that will display all connections. Although this arm may seem to have a few functions, there are many applications and implementations that can be added to it in the future.

Project Scope

Materials

1. Android Studio
2. Cardboard
3. PCB board
4. Soldering iron/tin
5. Temperature sensor
6. Ultrasonic sensor
7. Servos
8. Arduino UNO
9. 6.0 V, 2200 mAh, 3+2 AA Cells

Responsibilities

Team member	**Responsibilities**
Kevin Santizo	● Design and production of Ultrasonic Object Sensor ● App implementation of Ultrasonic Object Sensor ● Implementation of Login/Registration in app ● Design and functionality of app ● Design and production of Group PCB ● Testing of group hardware/software ● Documentation of project
(Alex) Narendre Ramdhan	● Design and production of bluetooth ● App implementation of Bluetooth ● Firebase implementation ● Design and functionality of app ● Design and production of Group PCB ● Testing of group hardware/software ● Documentation of project
Samad Agha	● Design and production of servo ● App implementation of Servos ● Firebase implementation ● Design and functionality of app ● Design and production of Group PCB ● Testing of group hardware/software ● Documentation of project
Henry To	● Design and production of temperature sensor ● App implementation of Temperature Sensor ● Implementation of Login/Registration in app ● Design and functionality of app ● Design and production of Group PCB ● Testing of group hardware/software ● Documentation of project

Project Plan

Hardware

Design of hardware

- We will be designing schematics and PCB design with the use of Fritzing program

Production of hardware

- We will each be sending our designs to SEEED and soldering components onto the PCB using on campus soldering iron. We will be getting cardboard from Samad.

Implementation of hardware

- Designing of the group PCB and code that runs the hardware

Software

Our major software we will be using is an app created by team members on Android Studio. We have created a single repository on GitHub which will be shared with all team members and professors associated with the project. We will be consistently pulling, committing and pushing functional code from Android Studio to GitHub with appropriate documentation with each commit. The main purpose of our software is to provide information about the hardware and be able to send input back to the hardware using Bluetooth connection.

- **App functions**
    - Implement manual controls for the SmartProstheticArm
        - Control speed of servo
        - Open and close hand
        - Flashing led lights
        - Reset button
    - Receive various data from the SmartProstheticArm
        - Temperature data
        - Servo speed
        - Ultrasonic object
    - Login/Registration
        - User will be able to register and login with the use of firebase as the database for this software

- **UI**
    - Simple and easy to navigate interface
    - Icons describing each menu
    - Hands free mode
    - Colorful and fancy
    - English and French

- **Implementation of Firebase**
    - Store user credentials in database
    - When a user logs in, the username and password will be checked against the remote database.

How we will complete it

- Creating project deadlines
- Organizing group discussion/meetings
- Quality checks
- Make sure app is always functional before pushing
- Testing of hardware/software
- Documentation of hardware/software

Constraints

Due to the pandemic we have limited access to the technology available on campus and group collaboration. Also there may be long shipping times due to the pandemic for PCBs and other parts which can limit our efficiency in meeting specific milestones for this project. We don't have easy access to a 3D printer currently to make the plastic frame of the prosthetic arm so we will be using cardboard for the first production of the SmartProstheticArm but will be upgrading to plastic in the future.

Expectations

For the final goal of this project we expect to deliver a fully functioning prosthetic arm. This would include:

- Functionality of all major hardware (servos, ultrasonic object sensor, temperature sensor, bluetooth)
- Functionality of login/registration in the software
- Functionality of Bluetooth communication between hardware/software
- Fully construct the smart prosthetic arm with all software and hardware functionalities working properly.
- To help disabled people and change lives

Theme: Cross-communication between the synthetic arm and a device

Epic: Use an Android app to send and receive commands wirelessly

Stories

- **Login/Registration**
  - We will use Google Firebase to provide user authentication, which will provide registration via email and password or a Google account.
  - There will also be basic validation such as checking for the right email/password. If it's not found, prompt the user to make an account.
  - We are also thinking of adding user customization, such as giving users the ability to rename the arm.

- **Connect through Bluetooth**
  - After the user logs in, the app will start scanning for bluetooth devices in range.
  - Our prosthetic arm will have an Arduino connected with a bluetooth module (HC-05)
  - The user can then tap on the HC-05 bluetooth connection and the app will initialize.

- **App Design**
  - When our team reviewed previous ICT Capstone projects at Humber, we noticed that many teams did not design their app very well. Therefore, we will follow the material design guidelines in order to make a clean and nice looking app.
  - Along with a clean interface, the app will be very easy to navigate. On default, the text/buttons will be large with a simple font so the user can read and use them effortlessly

Epic: Retrieving sensor data

Stories

- **Servo Motors**
  - Both Servo motors will connect to our app through Bluetooth. This enables the user to grip an object through our android app.

  - From the “Status” screen the user can tap on the Servos button to be redirected to a screen where a grip button is located. Once pressed the hand will close and be able to grip objects using the grip button.

- **Ultrasonic Object Sensor**
  - Readings from the ultrasonic sensor will be sent directly to our app through a bluetooth connection.

  - Within the “Status” screen of the app, the user can tap on the “Ultrasonic Sensor” button to examine how far (in cm) an object is within its palm.

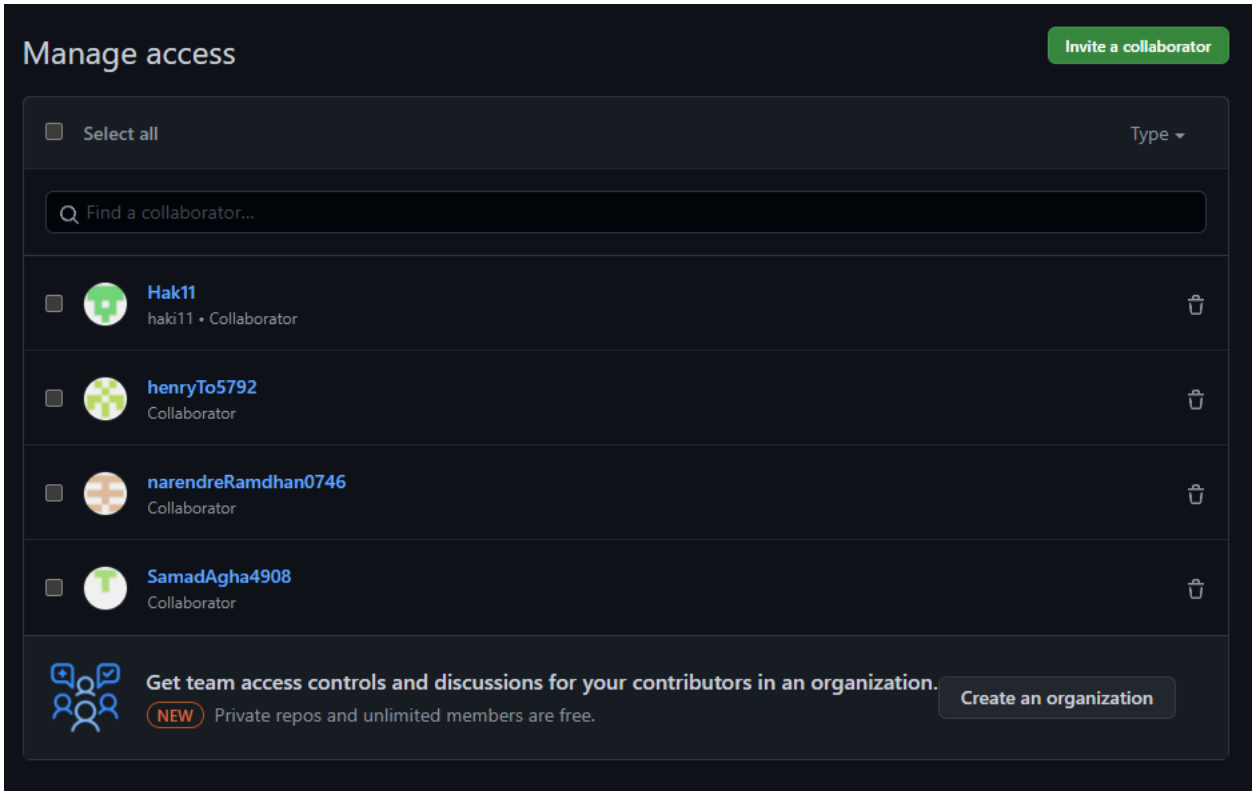
- **Temperature Sensor**
  - Through a Bluetooth wireless connection the temperature sensor readings will be sent to the app.

  - Clicking the temperature button within the status screen will enable the user to view temperature readings(in °C) from the sensor.

GitHub

GitHub Repo Name: SmartProstheticArm

GitHub Repo Link:

https://github.com/KevinSantizo2533/SmartProstheticArm

Screenshot of Github Invitations: