

GNG 2101

Introduction to Product Development and Management for Engineers and Computer Scientists

**Project Deliverable C: Conceptual Design, Project Plan, and Feasibility Study**

Lab Section: A02, Wednesday, Lab Group A7

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Date Submitted: October 1st , 2020

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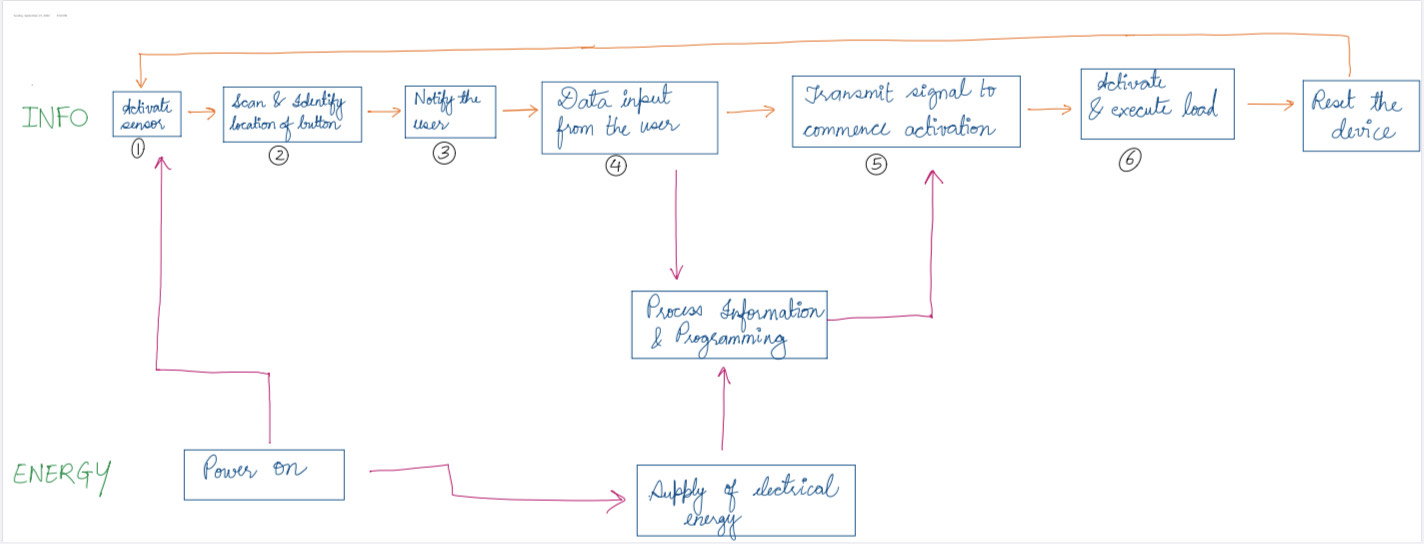
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Faculty of Engineering

2020

**Introduction:**

This document is necessary to outline and plan the future path of development that the group will be able to take, and also as a starting point and guide for the future development of our client prototypes. This deliverable brings us closer to the persistence loop where we can begin our prototyping phase and pursue product development. The feasibility study that is conducted illustrates the viability of our concepts and tests them against our constraints and target specs, thus ensuring that as we pursue the upcoming prototypes there will be an end result. Additionally, the uncertainties and risks are evaluated to predict our possible problems and potential setbacks.

**Functional Decomposition:**

**Concept Generation and Ideation:**

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| **Liam Kennedy Designs:** | | |
| **Design 1**  For this concept a remote control and an arduino sensor would be needed, additionally a small arduino processor may be necessary. The IR remote(transmitter) sends infrared pulses to the arduino IR sensor, the sensor converts the wavelength into electricity which will activate a sound from a small speaker and activate automatic switches from another button on the remote |  |  |
| **Design 2**.Watch/bracelet that detects IR emitted from a sensor embedded in automatic buttons the watch beeps faster as the user approaches the sensor. To which the user can activate the button with their own input | WOCCI Watch Straps 14mm 16mm 18mm 19mm 20mm 21mm 22mm 23mm 24mm Vintage Leather  Watch Band: Amazon.ca: Watches |  |
| **Design 3**.A jet of air could be blown at a high pressure outwards whilst creating a sound (help those who are both blind and deaf/ Just blind) the jet of air would help the user to find the exact position of the button within mm of the origin of the jet of air being produced the user could then activate the button via sensors | What Is A Rotary Screw Compressor? - Eaton Compressor | |
| **Design 4**.QR code scanner automatic buttons have their own individual website that the client can navigate with the aids already programmed into her phone. And can activate the automatic buttons via the website. | QR code - Wikipedia | iPhone 11 128GB Purple - Apple (CA) |

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| **Joshua Coutinho Designs:** | |
| **Design 5**  This first design would be a smart walking cane. This would include sensors that can detect objects 2 meters away, and have a button and light that can activate signals and buttons, all in a design that blind people would be comfortable with. |  |
| **Design 6**  This next design is a pocket sized arduino device that uses ultrasonic sound waves, that can hang from the user’s wrist and sense objects that the user is approaching, and vibrate to notify them. It can also activate a signal or button with the push of a button like a remote. This option is more compact and discrete. | Amazon.com: Geekcreit Ultrasonic Module HC-SR04 Distance Measuring Ranging  Transducer Sensor DC 5V 2-450cm: Everything Else |
| **Design 7**  The third design would be a device that works with a phone and extendable rod that straps onto the user’s wrist. The phone tracks any nearby objects using GPS tracking, and notifies the user. If there is a signal or crosswalk approaching a specific notification is sent, like a voice or vibration, and the user can push a button on the rod that makes it extend to push the button. |  |

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| **Jeta Thavarasah Designs:** | |
| **Design 8**  The first design concept would be to use arduino, with sensors. So how this would function is that the arduino would be programmed using C++ to identify the button using bluetooth and then once the sensor is activated an alarm is issued to the user and the user activates the buttons from the arduino. |  |
| **Design 9**  An app that can be accessible through IOS and android, that can be downloaded directly onto the clients phone. It enables the user to use voice commands and siri to help navigate around the area. Sensor programmed into phone to alert user and press the button. | |
| **Design 10**  Mechanical Design, an air pump that works alongside a sensor to extend to push a button every time it comes near an automatic button. This mechanism can be an extension to many of the designs and once the user is alerted, they can then push the button to release the rod, instead of using their own hand. |  |

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| **Prisha Shetty Designs:** | |
| **Design 11**  This design makes use of an AI app that can be installed on a smartphone. The smartphone will be secured on a wrist brace that the user can wear at their convenience. On the back of the brace, there will be a video recording device and a telescopic rod attached beside each other. The user hovers the video recording device over the area and communicates with the app via earphones using the voice over command. Once the app detects the automatic button, it will direct the user within 1 m of its line of sight, at which point the user activates the telescopic rod which will push the actuator of the automatic button and open the door for her |  |
| **Design 12**  This concept uses a photoelectric sensor to detect the automatic buttons. Using a diffuse-reflective sensor, the emitter element will emit a light beam and upon the sensing object, which changes the amount of light that is reflected on the receiver. Once the receiver detects this change, it will convert the image into an electrical output which can then be processed by an arduino circuit which will make a sound notifying the user of the desired object and then the user can manually activate the button following the sound |  |
| **Design 13**  This concept uses a radio controlled door opener mechanism. A situation where a beacon or a transmitter is installed in the lower section of the automatic buttons. When the user is near (50-100 m) the automatic button, they would click a button that would send out an electrical signal to the sensor which would then be recorded by the arduino board and then could activate the actuator and then open the door for the user handsfree |  |

**Evaluation and Ranking for all Design Concepts**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Metric | 1\* | 2 | 3 | 4 | 5 | 6\* | 7 | 8 | 9 | 10 | 11\* | 12 | 13 |
| Vibration strength | 2 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 |
| Mass | 5 | 5 | 1 | 5 | 3 | 4 | 2 | 3 | 4 | 3 | 4 | 3 | 5 |
| Range | 4 | 5 | 3 | 1 | 2 | 3 | 1 | 4 | 3 | 3 | 2 | 2 | 5 |
| Sound cue | 4 | 4 | 5 | 1 | 3 | 3 | 1 | 1 | 3 | 4 | 5 | 3 | 3 |
| Shock absorption | 2 | 1 | 3 | 3 | 5 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 |
| Dimension | 5 | 5 | 2 | 4 | 2 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 5 |
| Materials | 4 | 4 | 2 | 5 | 3 | 4 | 4 | 3 | 3 | 3 | 5 | 4 | 2 |
| Complexity | 4 | 3 | 2 | 5 | 4 | 4 | 5 | 4 | 2 | 4 | 5 | 3 | 3 |
| Performance | 5 | 4 | 3 | 2 | 3 | 4 | 3 | 3 | 3 | 3 | 5 | 4 | 4 |
| Intuitive | 5 | 4 | 5 | 3 | 5 | 5 | 4 | 3 | 4 | 4 | 5 | 5 | 4 |
| Cost | 3 | 4 | 2 | 5 | 3 | 3 | 3 | 4 | 3 | 4 | 5 | 4 | 3 |
| Protective covering protection | 2 | 1 | 5 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 |
| Water resistant | 2 | 1 | 5 | 1 | 2 | 1 | 4 | 1 | 1 | 2 | 1 | 1 | 1 |
| Capacity | 3 | 1 | 1 | 4 | 1 | 4 | 2 | 2 | 2 | 2 | 5 | 2 | 2 |
| TOTAL | 50\* | 43 | 40 | 42 | 36 | 47\* | 39 | 38 | 42 | 43 | 53\* | 39 | 42 |

**Legend:**

(1-5) scale, 1 lowest client impact. 5 greatest client impact

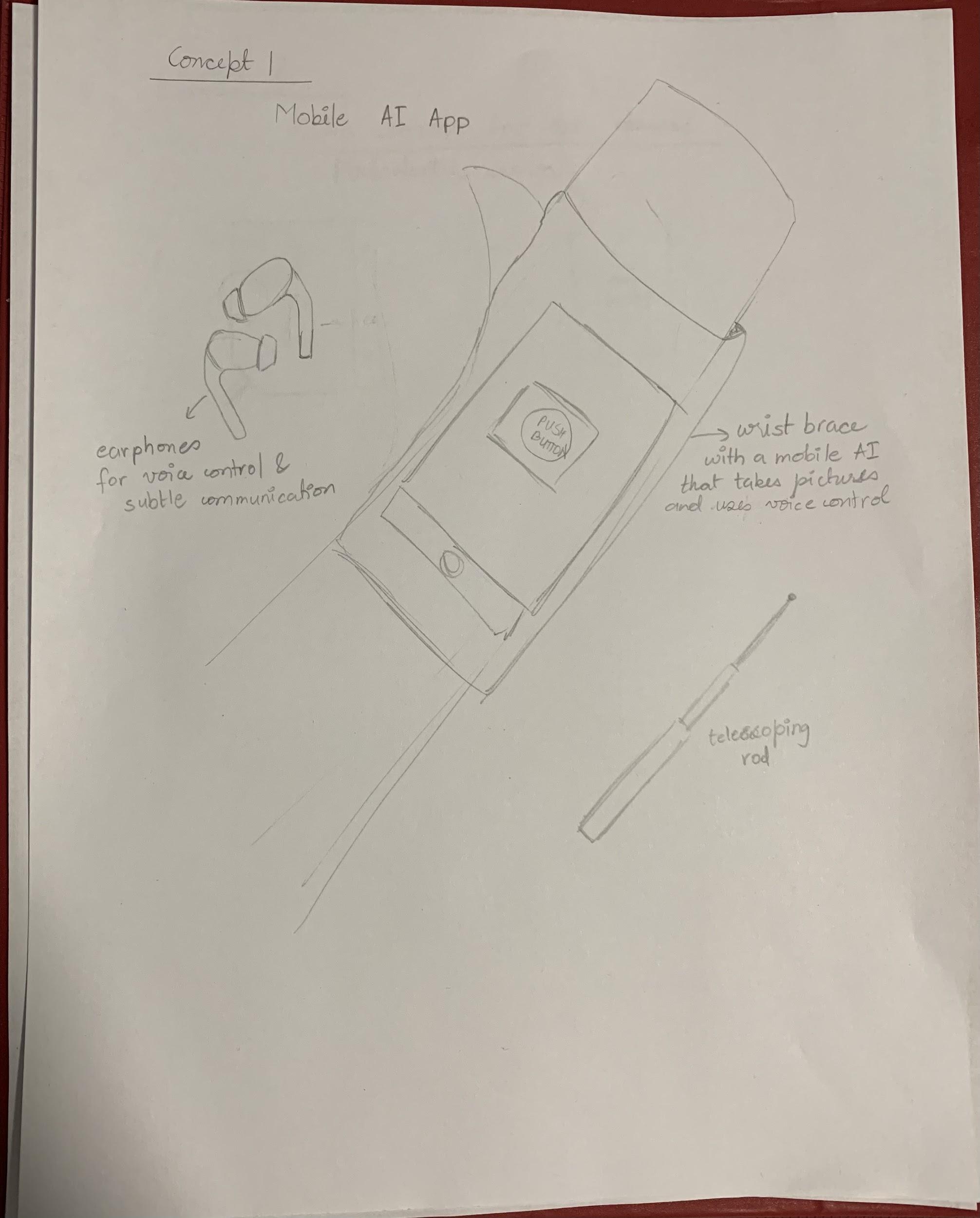
1. Design 1 IR remote
2. Design 2 IR watch
3. Design 3 Air jet aid
4. Design 4 QR code scanner
5. Design 5 Smart cane
6. Design 6 Ultrasonic arduino device
7. Design 7 GPS tracking + mechanical extension
8. Design 8 Bluetooth arduino connection
9. Design 9 IOS APP
10. Design 10 Air pump extension + sensor
11. Design 11 AI app + telescopic rod
12. Design 12 Photoelectric arduino device
13. Design 13 Radio controlled device

**Evaluation Scheme**

Upon evaluating and assigning a rank for all design concepts outlined by the target specifications in deliverable B, designs of the AI app + telescopic rod, IR remote and the ultrasonic arduino device were unanimously chosen based on their cost, performance and complexity. These design concepts were presented to the client during the second meeting and feedback was obtained.

**Group Design Concept**

Based on the results from the target specifications and discussion with the clients at the client meeting II and the client provided us with some great feedback. Kim and Nolan were interested in the AI app installation on a wrist brace that facilitates voice over commands and notifies the user using earphones. Once the 3D object (automatic buttons) are detected, the app will guide the user towards the button within a 1m radius and then a telescopic rod could be extended to actuate the automatic buttons and executing the desired function of opening doors, pushing elevator buttons and activating the traffic light buttons. Since the client is familiar with using Seeing AI and using voice control, she encouraged us to develop and build a prototype that involved an AI feature.



**Benefits**

The benefits using this concept is that it reduces the need to develop external hardware such as arduino circuits and motor devices. It can be easily installed on a wrist brace and would make it easily accessible for the user and still allow decent hand mobility. A telescopic rod can extend and activate the actuator on the automatic button, eliminating the need to be in contact with the automatic button.

**Uncertainty and Risks**

For this project there are several risks and uncertainties. One is that we don't know if we will be able to program a device with the arduino to perform functions that include both turning on a light and cueing a sound at the same time. Another uncertainty is for the telescopic rod we are not certain if the user will be able to correctly identify where the button is exactly and press the button successfully. Another uncertainty we have is for the app we don't know if the camera scanner will be able to identify all types of buttons at different weather conditions. Also if there are slight differences in separate automatic buttons the app may not be able to recognize it. Additionally we are unsure if we will be able to access the source code already available for the application seeing AI.

**Feasibility Study (TELOS):**

**Technical**

For this project if the team was to follow through with the arduino design idea, having to program the system to activate a sensor and identify the button then alert the user. The technicality of this design would require writing code in C++. However, the majority of the team does not have experience with coding, so each team member will need to practice and learn the software individually. This same concern applies with the AI app as well, the coding to run the app to scan pictures of the automatic buttons will need to be learned. On the other hand, the telescopic rod can be built by using CAD or solidworks software to design the object then have it 3-D printed.

**Economic**

The cost of the project can indeed be afforded as the arduino kit can be purchased or provided by the university. Any other wires or electrical components can be purchased through amazon for a low budget. Also any 3D printing needed, can be done for free at the University. The total expenses of this project is estimated to be below 100, which is the given budget of the project.

**Legal**

Legally the project is achievable as all software and programs used will be open to the team. The project will also be viewed by the project manager to ensure that no illegal activity is being conducted. No infringement will be made to any patent and trademark laws. Team Contract signed will be followed.

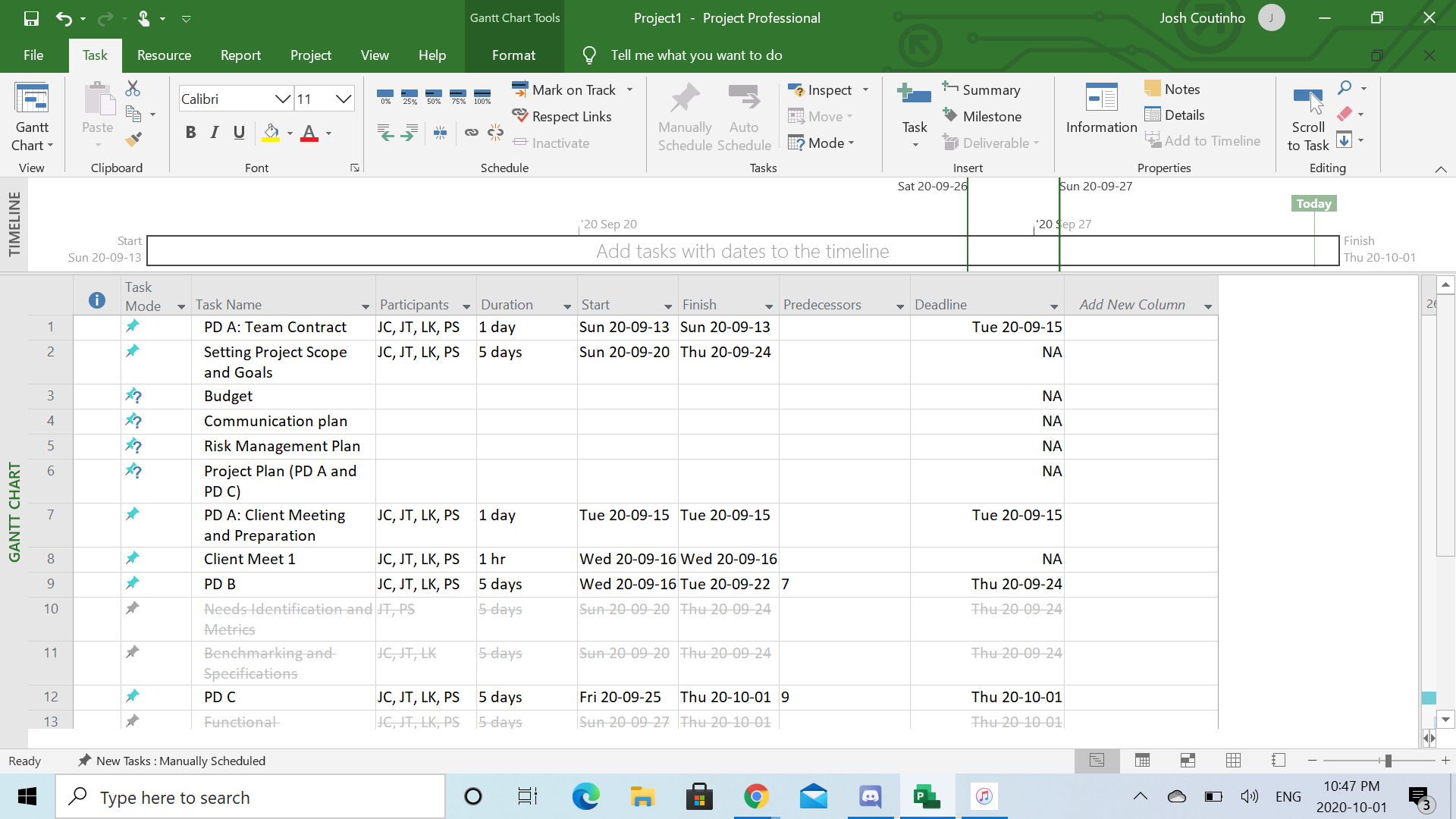
**Operational**

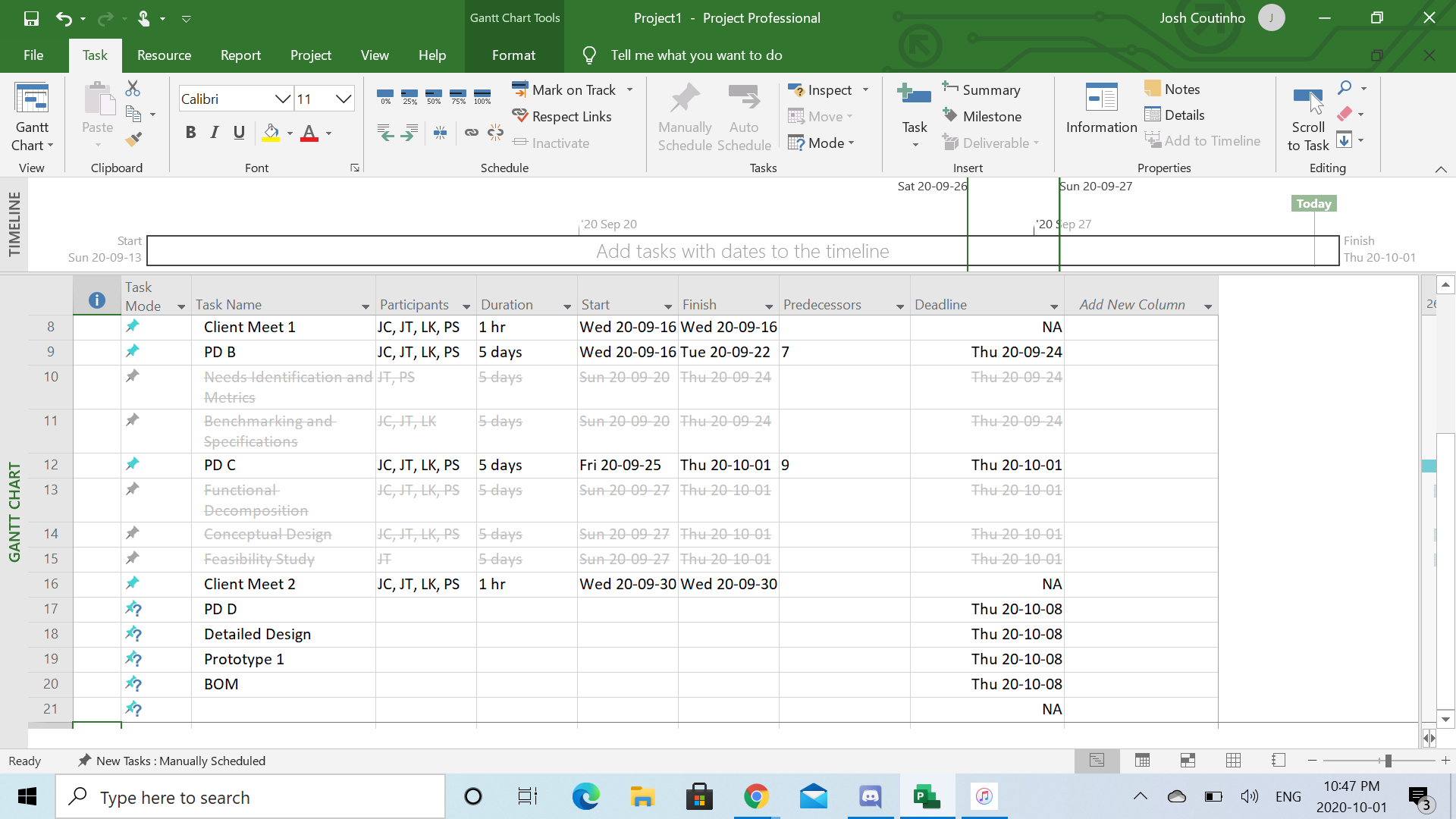
In order for the project to be successful team members will be required to do additional training in using the arduino and the software needed. There are no organizational constraints prohibiting the team from continuing with the project. The project can be operated by many users with disabilities.

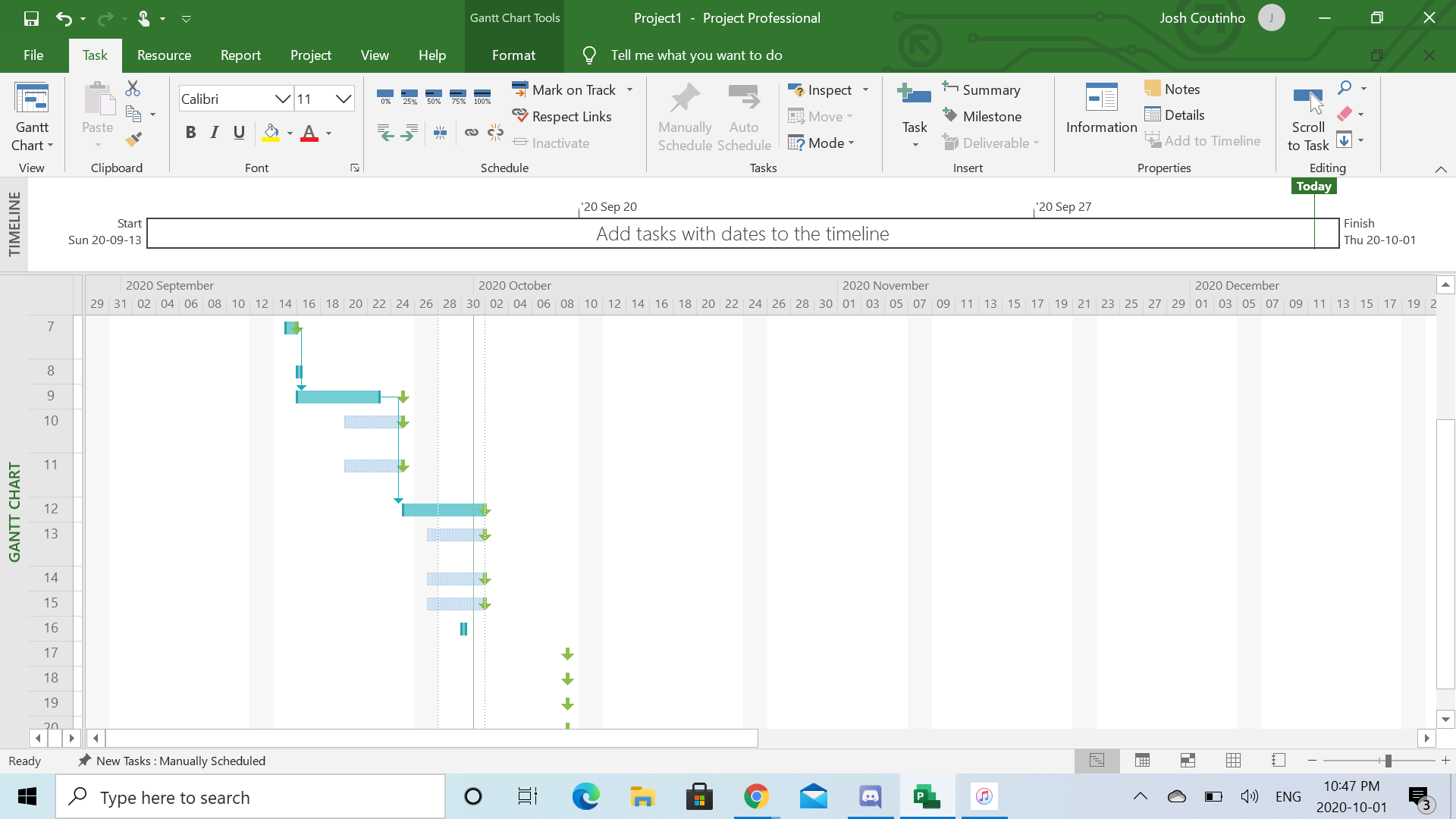
**Scheduling**

The project must be completed and functional in time for design day. For that reason a strict schedule is going to be followed by the team to finish tasks and the number of prototypes required on time. There should be no issues with the milestones benign met by their respective deadlines.

**Microsoft Project Plan Gantt Charts:**

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