Project Deliverable C - Conceptual Design, Project Plan, and Feasibility Study

GNG2101

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Group E14

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Introduction

After the study of SenseAct we start to design the interface. First we will understand the main function and sub-tasks on our project and draw the picture of functional decomposition, then we will list out all of our ideas and filter some of them that meet our concepts and we all agree with, and generate them into one idea with a description and a picture. Next we will organize our future plan, after that the feasibility of our plan will be discussed at the end.

Functional Decomposition

In this section, we used the design criteria to break down essential product functions and smaller sub-functions according to information flow, material flow and energy flow. Our functional decomposition contains organized tasks in a sequence that help satisfy customer needs.
The main function of our device is to be a simple user interface that allows users with different disabilities to communicate with health workers. Basic functionalities of our product include, turning on, offering the user options and using the feedback to perform the required task then returning to the main menu. The following paragraphs describe each flow in detail.
Information:
The information refers to how the device gathers information from the user and how the interface will function using such information. To begin, the application starts and asks for input from the user, the first of which is device options (i.e. joystick or touch sensor), the second of which will be the usage of the device (i.e. computer mouse or tv controller). Next the interface will take the input from the user and send it to SensAct, which contains the program that translates the electronics part to what the user would like completed. The SensAct then sends the output (based upon said electronics) to the system and the user is able to test if their device functions in their desired way. The interface will stay active to monitor that the device is functioning properly and once the task is completed the interface will offer to return to the main menu to set up another device or exit the interface.
Materials:
The materials for this product will be referred to as the users who will be using the device to perform different functions. First the user will launch the interface to access the available options of the device from the main menu. Next the user will have two functionality options to choose from, the first being the basic option which will lead to a menu to select the device a patient wants to use. Second is the advanced functionality, which will lead the user to a menu with devices that can be edited to have more functionality than the basic devices, there is also the option to add a new device. The next step is for the user to use the functionality selected previously, a use could be identified as an internal task, such as moving a cursor on a computer

screen, or an external task, such as turning on the TV. After the user has achieved their purpose from the device, they are able to return to the main menu and exit the app if they are done using the interface.

Energy

Since our product is a user interface, the main source of energy in our product is electricity. When electricity flows in, our device will turn on and when turned off, the flow of electricity stops.

Main Function

[Turn on device]→[Select desired functionality]→[Use functionality to perform task]→[Turn off Device]

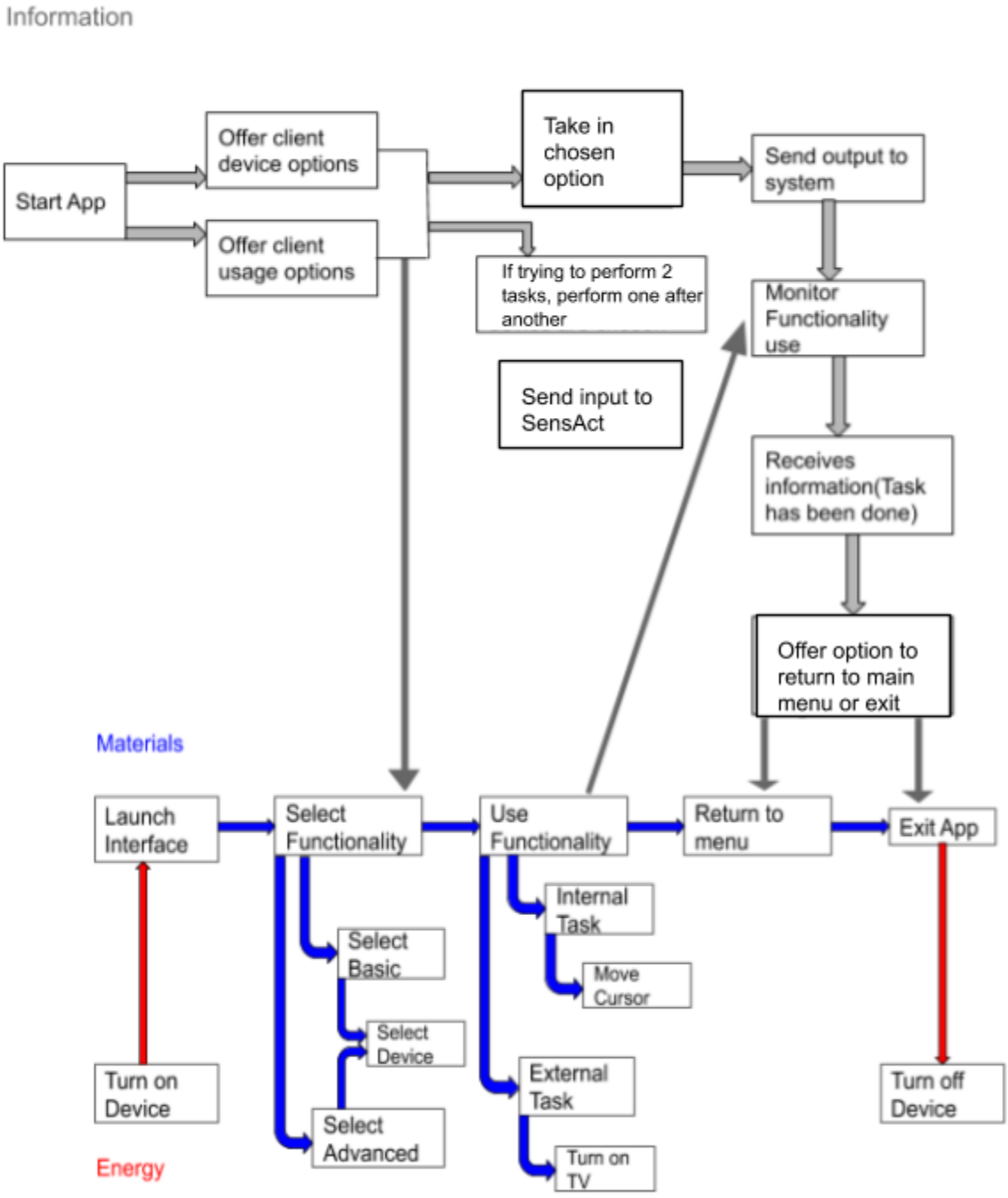


Figure 1. Functional Decomposition Flow Diagram

Visual Representation of the Ideas

- An interface including a picture-button system, which the user can hover over to read the basic function of each option/button.
- Also contains a system where the main menu contains several different categories based on the accommodations of the patient, after this is selected it takes the user to a screen asking whether the user wants a more basic configuration or advanced one where they get more options
    1. The first column is the first screen displaying what the settings the user wants which is based on their ability.
    2. The second column is a choice based on a more advanced configuration or more basic configuration. This allows the user being a patient to choose a pre programmed basic interface easy to control devices with, and also allows the user being a health worker or technologist with more programming knowledge to choose a more advanced interface with more setting options that they might understand.
    3. The third column then gives the user the ability to select what devices they wish to control.

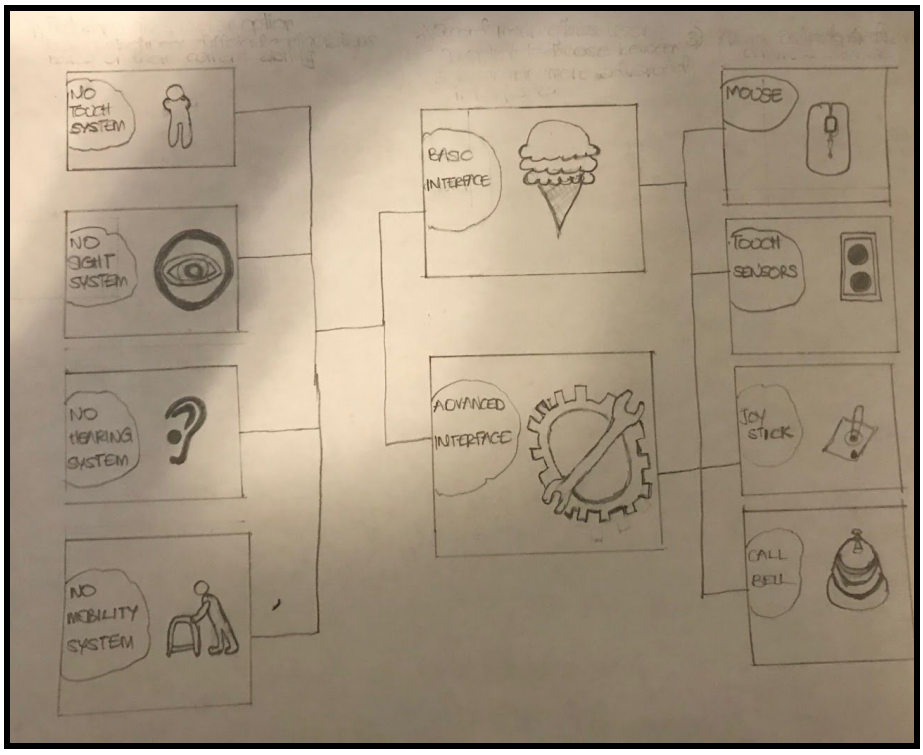
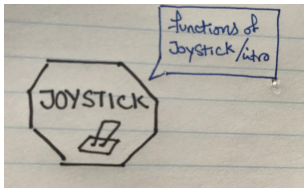


Figure 2. Visualization of interface

Conceptual design

Anika

- Main problem with SensAct was the overwhelming amount of options and hard navigations and requires complex configurations to complete functions. With ours, the user is only given the option of choosing one thing at a time, that way the interface is able to completely guide the user through the choices they have to make. Users can choose Inputs, then State and triggers to have the system work
- Since workers may not have technical knowledge, when allowing inputs such as raspberry pi, our buttons will include images



- Our buttons will allow the user to hover over it to give them a brief description of what that input will be able to do.
- Could also have pre-programmed functioning buttons for common tasks. For example, I've seen node-RED tutorials where amongst many buttons, pressing one button will fully perform a pre programmed task. (ex: Turn on lights)
- Help button with written instructions (only if necessary)

Omar

- Specify categories on the interface with options and devices detailed for different types of patients/staff. So for every category of people have options and devices tailored for their needs during their stay in the hospital. For example, elderly with physical disabilities, they would have a category which will show a menu with devices they may need to use, such as a remote for TV, and/or joystick to navigate on a monitor.
- Add a voice command option to the interface, which allows the patients to select different options through voice recognition. The voice command can also be used for on-screen typing for patients with less mobility.
- A command that asks the user what operation that will be performed, then takes them to the menu with options involving that specific operation. For example: the patient wants to watch TV, the user will then go the operation called TV and is directed to a menu with different options specific to the TV

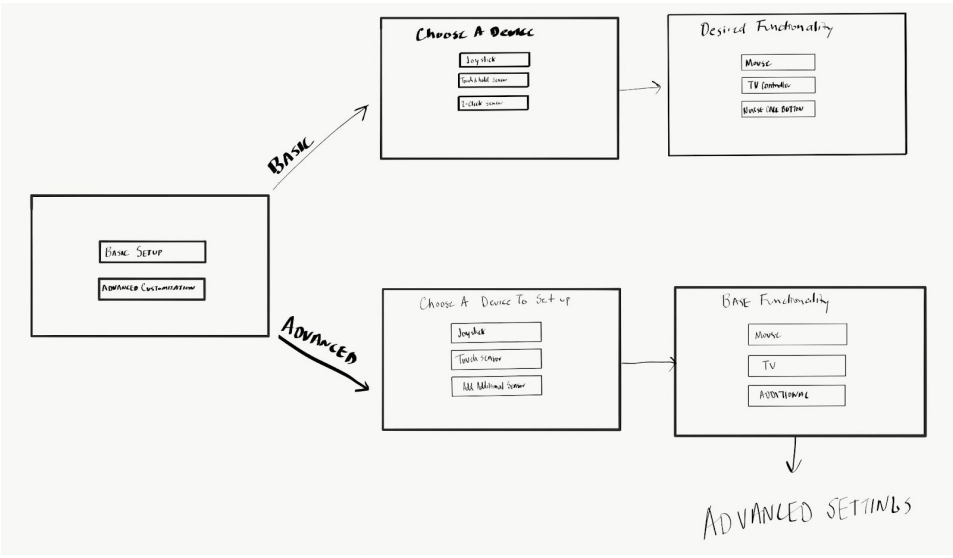
William

- Set up most coding parts and the user needs to choose what the device is going to do and which controller is using, then a tutorial video will pop up, to teach the patient how to use it.

- The interface is designed like a control panel, the user will be ask to choose the controller, then the control panel will pop up with a lot buttons those buttons are made to customize the use of each access point on the controller (such as open TV, or turn up the volume) so the patient can switch by themselves easily.
- The setting details will be explained by videos in each step, it can let the user understand the use of different parameters easily. For example, the setup of mouse speed will be taught during the video and the speed of different parameters will be simulated during the video.

Fiona

- Design #1 **[2 menu system]**:
    - Implements a "2 menu system", one system will be basic for an average user, mainly a family member that may be setting up the SensAct device for the patient. It strips everything down to its basics, but allows little customization and configuration. The user will select basic, select their device, and their functionality, and everything will be set up for them to use. The second menu system is more complex for nurses or technicians who have a bit more of an understanding of SensAct it allows for complete customization while still keeping the interface simple. This is going to be done by having multiple screens with prompts they can easily select from until they get their desired final functionality.
    - Rough sketch of design #1 idea:



- Design # 2 **[Basic User Interface/Little Customization]**:
    - A user interface that focuses less on customization and more on functionality and user friendliness. This will be done by keeping it all simple, and having all the options being basic. Ideally, the user simply selects the device, then will be presented with options of functionality, and then specific functionality. For

example, they could set up a touch sensor, by selecting the touch sensor, then TV controller, then volume control.

- Design #3 **[Advanced customization]**:
    - A user interface that will be relatively robust in order to allow for customization. It will be slightly more complex however to accommodate for that and still keep it user friendly, there can be an option for more information if a user needs help on setting up their SensAct. It will allow for more user inputs in order to ensure they have complete customization over their devices. Unlike the previous designs, it would not simply present buttons and options to pick from but will require more user input and information.

Joshua

- Audio Based(1)- Using a system similar to the prototype but with more options in controls of the input devices like more clicks of the joystick relate to more choices for controlling the device. Planned to add an audio configuration to help patients who may not be able to see or might understand better when spoken to for each option they choose.
- Extremely Basic(2)- Have an interface with fewer options in the main menu which just has a start button and that button takes you straight to the page where the user can choose either between a joystick or a call bell which are the two most essential input devices needed. This interface would be extremely simple and would look cleaner than the current one.
- Video Communication system(3) - Integrating a camera system to connect to the SensAct device as an input device, this would enable all forms of communication and would replace a call bell and allow for other input devices that are needed. The patient can simply call for help using the camera or still use a joystick to control an external device. This way the interface would require less connected inputs and less buttons making it easier to understand.

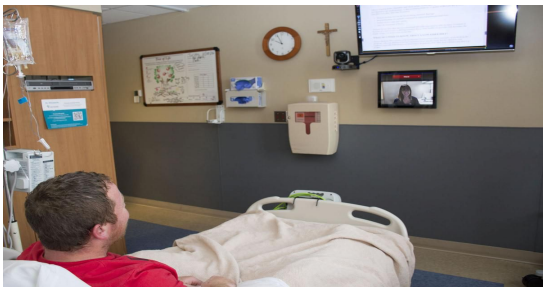


Table 1: Grouping Concepts

Subsystems
Concept 1-Focus on Usability
Menu system
Limited options at once
Buttons with pictures
Customized based on disabilities
Basic and Advanced categories
Help button for more information
Audio Instructions
Concept 2-Only Essentials
Pre-programmed common functions (one button)
Commands through voice recognition (like siri)
Limit options - Only focus on the most essential functionality
Concept 3-Focus on Customization
Tutorial videos teaching workers commands
ability to change actions that prompt a function (to suit patients)
Choose commands - specified options for each command
Replace call bell input with camera to monitor patients

Table 2: Decision Matrix

Numerical Criteria Values: 1[lowest]-5[Highest]

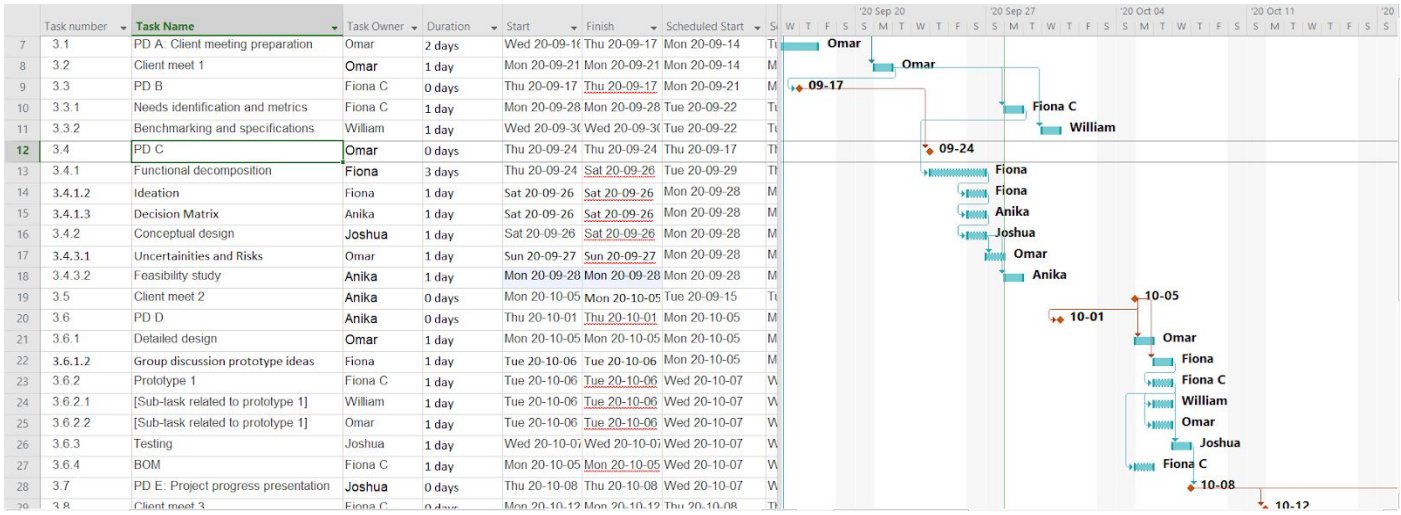
Concept Options				
Selection Criteria	Weight	Concept1	Concept2	Concept3
No technical background required	0.23	5	4	2
Accessible on varying devices	0.17	3	3	4
Simplicity	0.13	4	5	1
Shortcuts	0.02	3	5	2
Customizable options	0.15	4	1	5
Scalability	0.03	3	2	5
Easy Navigation	0.05	5	5	2
Intuitivity	0.1	4	5	1
Visual Representation	0.05	5	2	3
Low Cost	0.07	4	5	2
Total Score	1	4.11	3.59	2.7

Using the decision matrix, we have concluded that the ideas grouped under usability are the most useful, given our client requirements.

Analysis

From the previous client meeting and needs identification, the client's desires in the final project were made clear in that he wants a user-friendly interface that is still capable of varying kinds of configurations. Individually we all brainstormed multiple possible concepts that were able to satisfy his needs at different levels. The three main kinds of criteria that the design encompassed includes usability, essentials, and customization. As seen in the decision matrix, when compared to the design criteria and needs identification previously found, conceptual designs that focused on usability are the best fit for resolving the client’s issue, whereas a focus on customization had the lowest score because to offer more customization options may result in

a more complicated user interface. Specifically, for example, a complex design that allows more customization may require some hardware/software knowledge which already does not meet one of the design criteria. The final design took the varying ideas from concept 1 and combined them to make this interface as user-friendly as possible. The benefits of the final design is that it meets all the requirements. The final design allows users to have the simplest possible user interface that requires no additional electronics or programming knowledge while also allowing users to further customize their device if desired. The drawbacks however are that by attempting to provide users with an "easy to navigate" design so that we meet most of the criteria we end up having to take away some of the customization aspects. In the original program, users are able to completely customize their device to perform any action they desire, however that resulted in a relatively complex system that requires previous knowledge to use. Despite this drawback, we are content that our current design meets all the requirements to some degree, and the only design criteria that can not be fully satisfied is an interface capable of fully customizing the SensAct.



	Task number	Task Name	Task Owner	Duration	Start	Finish	Scheduled Start
7	3.1	PD A: Client meeting preparation	Omar	2 days	Wed 20-09-16	Thu 20-09-17	Mon 20-09-14
8	3.2	Client meet 1	Omar	1 day	Mon 20-09-21	Mon 20-09-21	Mon 20-09-14
9	3.3	PD B	Fiona C	0 days	Thu 20-09-17	Thu 20-09-17	Mon 20-09-21
10	3.3.1	Needs identification and metrics	Fiona C	1 day	Mon 20-09-28	Mon 20-09-28	Tue 20-09-22
11	3.3.2	Benchmarking and specifications	William	1 day	Wed 20-09-30	Wed 20-09-30	Tue 20-09-22
12	3.4	PD C	Omar	0 days	Thu 20-09-24	Thu 20-09-24	Thu 20-09-17
13	3.4.1	Functional decomposition	Fiona	3 days	Thu 20-09-24	Sat 20-09-26	Tue 20-09-29
14	3.4.1.2	Ideation	Fiona	1 day	Sat 20-09-26	Sat 20-09-26	Mon 20-09-28
15	3.4.1.3	Decision Matrix	Anika	1 day	Sat 20-09-26	Sat 20-09-26	Mon 20-09-28
16	3.4.2	Conceptual design	Joshua	1 day	Sat 20-09-26	Sat 20-09-26	Mon 20-09-28
17	3.4.3.1	Uncertainities and Risks	Omar	1 day	Sun 20-09-27	Sun 20-09-27	Mon 20-09-28
18	3.4.3.2	Feasibility study	Anika	1 day	Mon 20-09-28	Mon 20-09-28	Mon 20-09-28
19	3.5	Client meet 2	Anika	0 days	Mon 20-10-05	Mon 20-10-05	Tue 20-09-15
20	3.6	PD D	Anika	0 days	Thu 20-10-01	Thu 20-10-01	Mon 20-10-05
21	3.6.1	Detailed design	Omar	1 day	Mon 20-10-05	Mon 20-10-05	Mon 20-10-05
22	3.6.1.2	Group discussion prototype ideas	Fiona	1 day	Tue 20-10-06	Tue 20-10-06	Mon 20-10-05
23	3.6.2	Prototype 1	Fiona C	1 day	Tue 20-10-06	Tue 20-10-06	Wed 20-10-07
24	3.6.2.1	[Sub-task related to prototype 1]	William	1 day	Tue 20-10-06	Tue 20-10-06	Wed 20-10-07
25	3.6.2.2	[Sub-task related to prototype 1]	Omar	1 day	Tue 20-10-06	Tue 20-10-06	Wed 20-10-07
26	3.6.3	Testing	Joshua	1 day	Wed 20-10-07	Wed 20-10-07	Wed 20-10-07
27	3.6.4	BOM	Fiona C	1 day	Mon 20-10-05	Mon 20-10-05	Wed 20-10-07
28	3.7	PD E: Project progress presentation	Joshua	0 days	Thu 20-10-08	Thu 20-10-08	Wed 20-10-07

Figure 3. Project Plan

Updated project plan on Microsoft Projects, additional information provided in a separate pdf.

Feasibility Study

Uncertainties and Risks associated with SensAct:

1. There is a risk that if we are to create a user interface that is user friendly, we may end up limiting how customizable it is, thus resulting in fewer patients using the SensAct to the best of its ability.
2. There is a time/communication uncertainty with the project because we are looking to create a relatively robust user interface that is still friendly, however due to COVID it is harder to meet as a group and work on the project all together. This includes being able to actually test the project.
3. There is an uncertainty that we can create a product that is usable by everyone. This means that by creating a product that requires no background knowledge of software/hardware for users such as a nurse or a family member, we are limiting what an advanced user could use SensAct for.
4. There is a risk that in the future the interface cannot be updated to allow further advancements because by changing the interface to be as simple as possible, it may not allow further advancements to avoid the interface becoming complex again.
5. There is a resource risk that because we do not have access to a raspberry pi or SensAct, our prototyping and development could be hindered. This is because we will be limited in prototype testing.
6. There is an uncertainty that our group can successfully learn and develop our desired interface on node-red due to the lack in our programming skills and background knowledge of node-red.

Table 3: TELOS FACTORS

Factors	Feasibility	Description
Technical	Feasible	A similar project was completed using Java to create the SensAct user interface. Our concept plans on using Node-RED to create a simpler version of that interface. Our client demonstrated confidence in Node-RED's ability to implement the user needs. Through research, we have found some video tutorials on how to implement functions on Node-RED which should help us with our project. Therefore, we have enough technical resources and our project

		is technically feasible.
Economic	Feasible	Budget: $50 Node-RED is a free downloadable software, and our primary requirement for this project so ideally we will be under budget, making our project economically feasible. We currently have not allocated our budget to anything simply because the software we are operating on is free but if we need to make purchases, they will be very minor and fall within the constraints of our budget.
Legal	Feasible	Remodelling of the Sens Act Interface has no negative legal implications as we had permission from the owner(client) of the device before we initiated our project. We also received permission from the Engineering Faculty of the University of Ottawa before we started working towards our project.
Operational	Feasible	Software Platform: Node-RED Our project is predominantly online based and we have complete access to the software platform. Therefore, our project does not have any organizational constraints due to the ongoing pandemic and the fact that we have access to all our technical requirements.
Scheduling	Feasible	Time constraint: Design day 3-12-20 Our project requires a lot of time, but through planning and consistency in completing project milestones (shown in our project plan), this project is feasible to complete within our time constraint.

Lifelong Learning-Transfer of Knowledge

All members of the E14 Team have taken GNG 1106 or python in the past which has given us a basic background in programming as well as an understanding of C programming language. Knowledge on C will be applied to remodelling the interface of SensAct since the use of Node Red requires programming as well, our knowledge on C can help us understand Node Red and its features. The use of loops will be very essential to this project, along with the use of ordered functions which were all topics learnt in GNG 1106. The Dashboard is also similar to C in terms of the way its variables (called nodes on Node Red) can be arranged in strings and numbers.

Node red being a drag and drop dashboard version of Java programming makes it relatively easy for the group members on our team who took ITI programming classes in first year. It builds on Java programming by providing a more visual representation of it where nodes can be dragged and dropped rather than just writing codes unto a command window. The organization of codes learnt in Java coding can be applied here to group and organize nodes efficiently to make the codes look understandable to a viewer, and in order to improve the efficiency of the codes in general. The use of Node Red to this extent could also extend our knowledge of Java since we get to use it in a more challenging and practical way.

Our use of cell touch screen cell phones has given us an understanding of arranging applications in a colour coded way which will allow us to arrange the buttons on the interface in a way that makes the interface much easier to operate.

The use of dependencies when making project plans can be used to help map out the connections of nodes done on the Node Red dashboard, which makes finding the dependencies between nodes easier. This can also improve our ability to find dependencies between figures, objects, and even events which can always be useful in planning out activities more effectively.

Conclusion

In conclusion, this deliverable gave us the view of what our product should be, and helped us to generate the contour of our product. We brainstormed for the design of our product and combined some of them into one idea and decided what we should do next. There were two problems that we were facing during this deliverable. The first one is we had a misunderstanding about our client's needs. This was caused by the time limitation on client meetings and the amount of basic information that we need to know during the client meeting.however, it was solved by contact with our professor, our TA, and our client. The other problem that we faced during this deliverable is some of us have some issue on time management, we took it seriously

and discussed it during our group meeting and it was solved. Even though we had some mistakes, we still finished everything perfectly.