Project Deliverable C:
Conceptual Design, Project Plan, BOM and Feasibility Study
GNG 2101
Intro. to Product Dev. and Mgmt. for Engineers Faculty of Engineering
University of Ottawa

Objective

Developing a conceptual design for the product and create a plan for completing multiple prototypes in time for Design Day. Provide a bill of materials and parts (BOM), as well as a feasibility study to verify the viability of our proposed concept.

C.1 Conceptual Design.

1. Based on customer needs, clarify core functionality by breaking down required product functions (functional decomposition) into smaller basic sub-functions, identifying external sub-system boundaries.

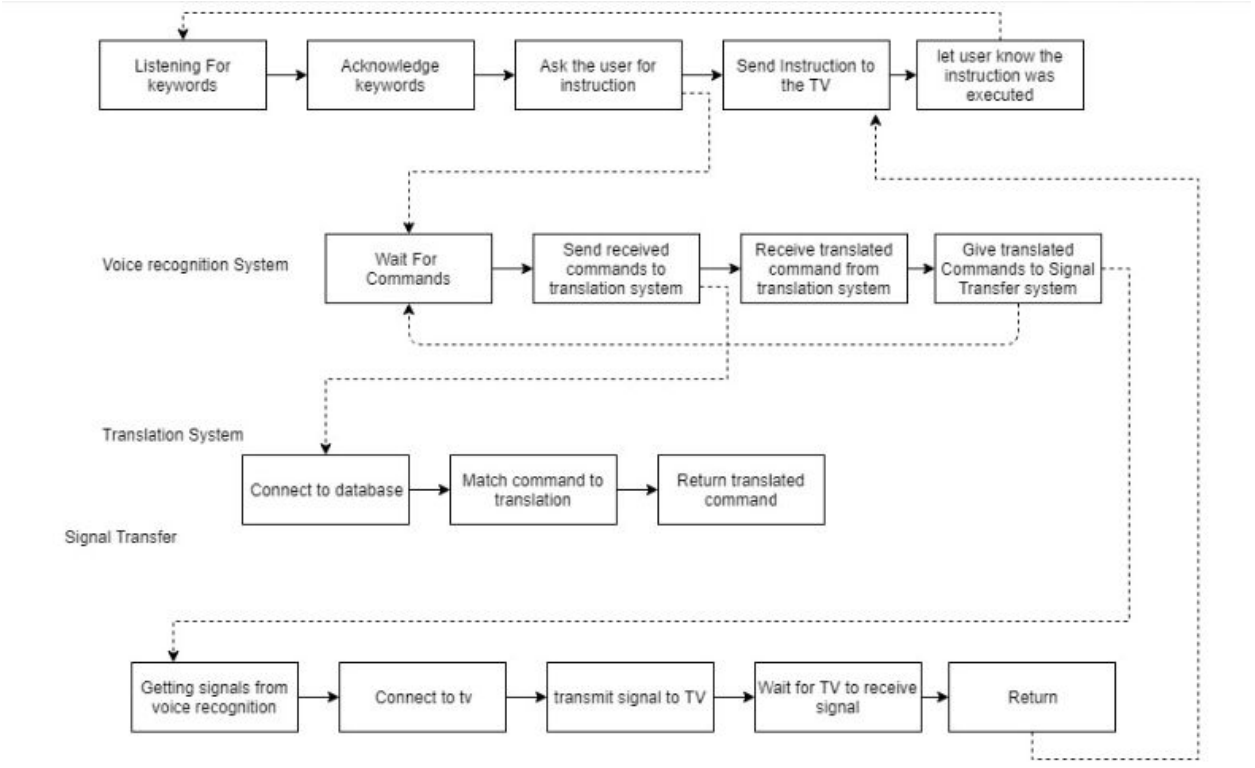

Figure 1: Voice Remote Core Functionality Block.

2. Provide a minimum of 3 product concepts per team member (clearly identify each concept's creator).

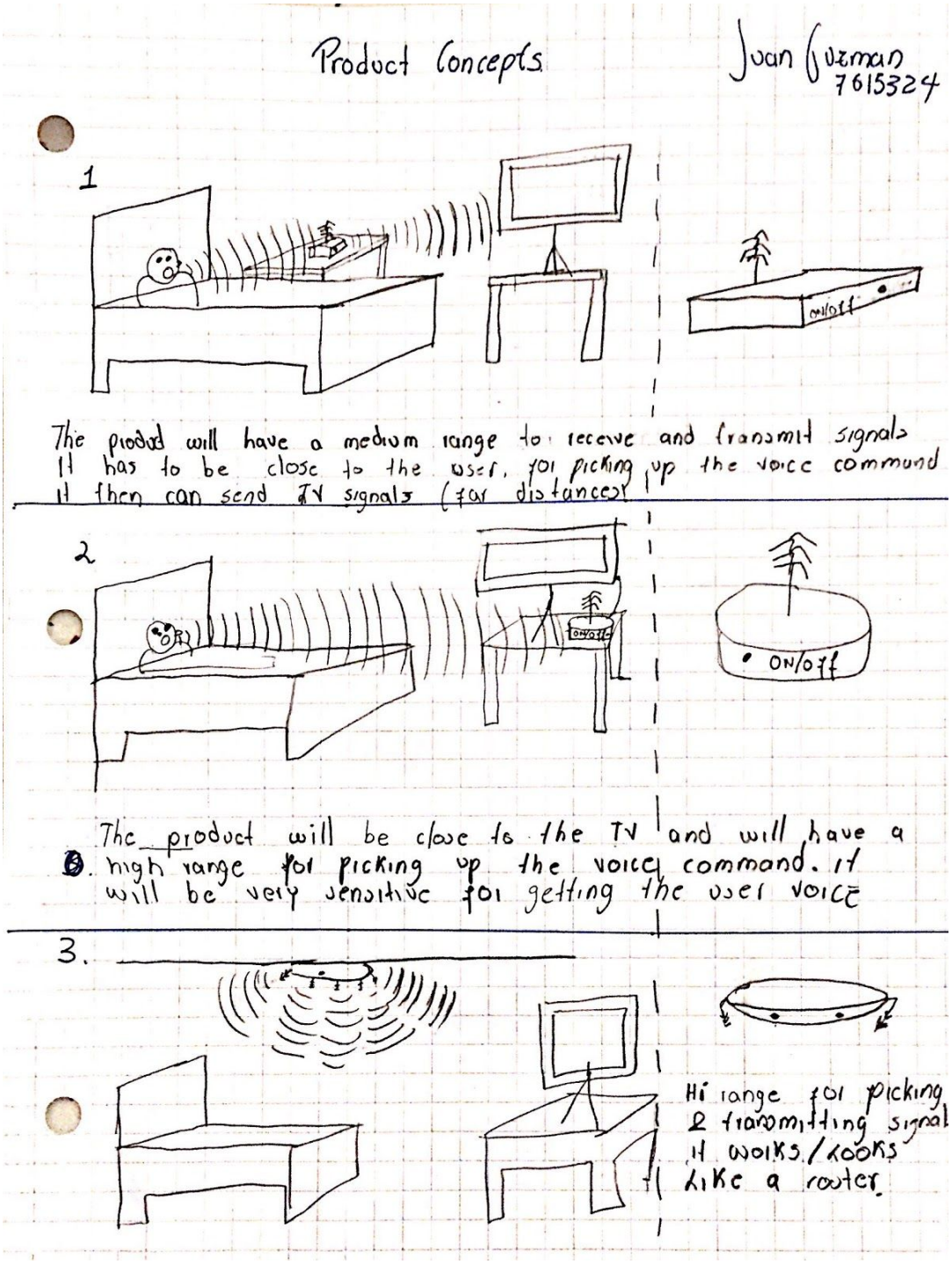

Figure 2. Juan Guzman's concept designs

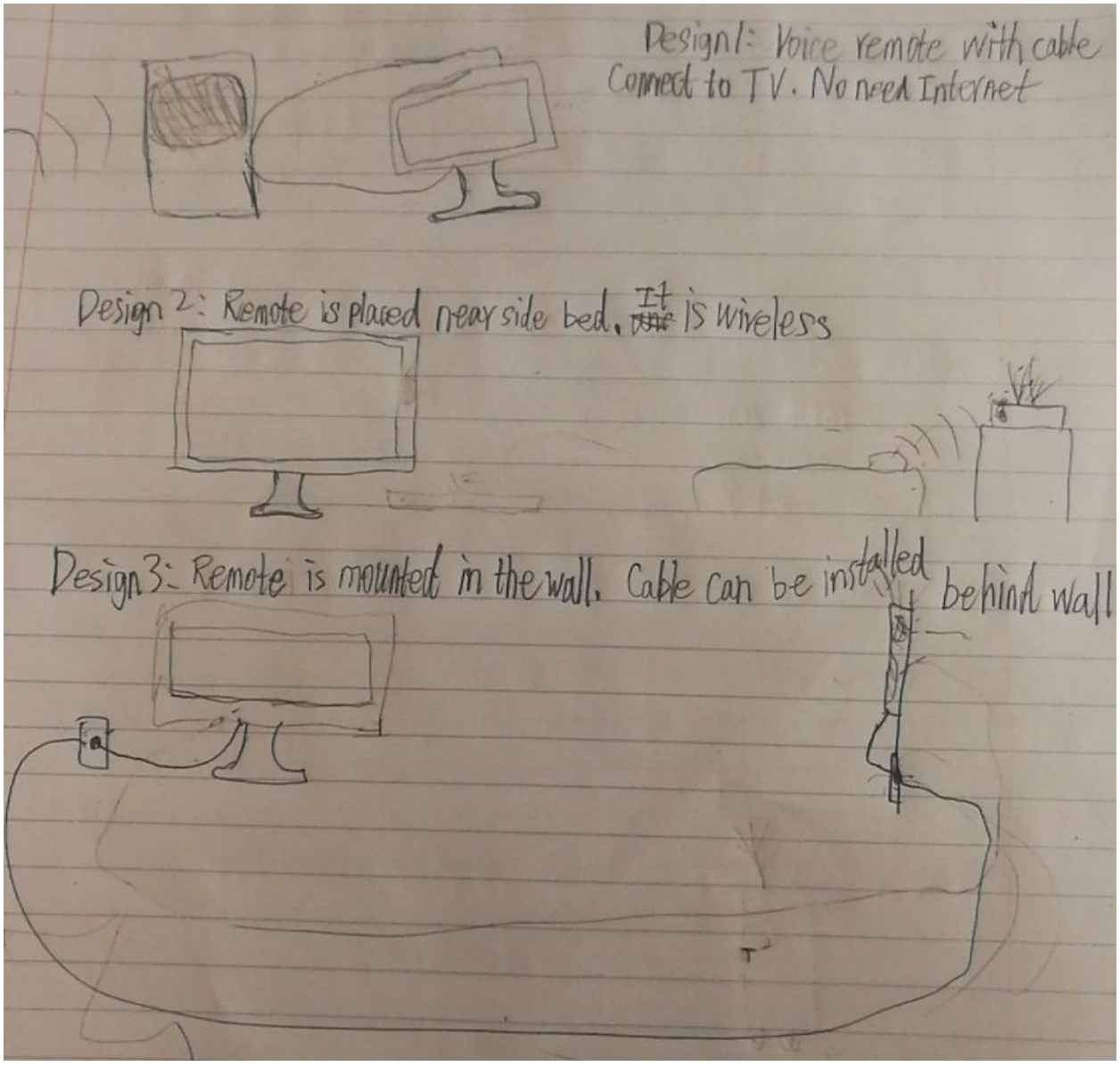

Figure 3. Sike (Bruce) Yin's concept designs

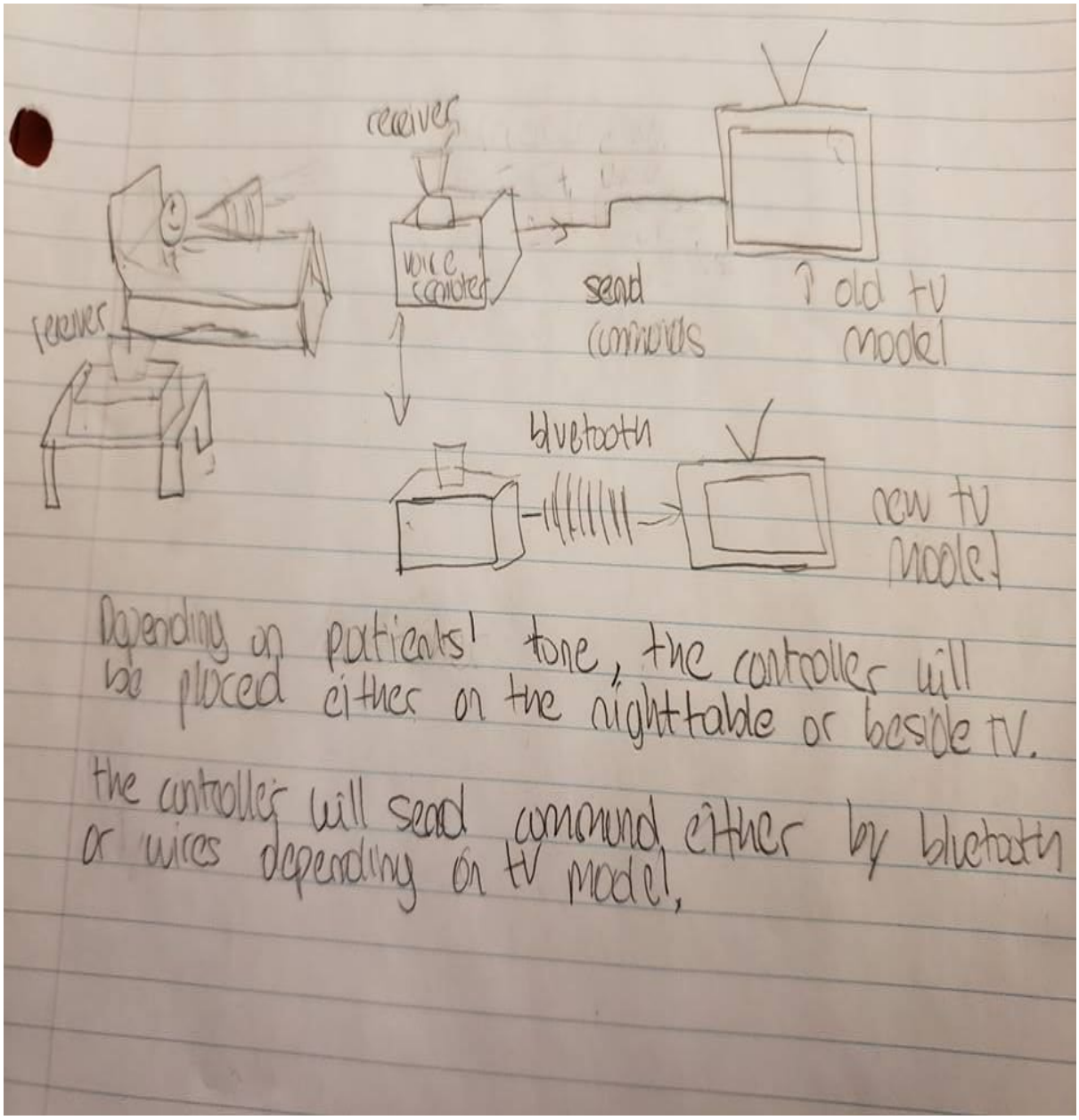

Figure 4:Nicolas Salcedo's concept design.

3. Analyze and evaluate all concepts provided by each team member based on the target specifications of Project Deliverable B. Use simple calculations and/or simulations to make decisions. Justify the process and methods used for analysis and evaluation.

We know that decision matrices can help us select the best option from the 9 concepts that were provided by each member of the team. We selected the selection criteria of the decision matrix based on the target specifications from Deliverable B . We added the weight factor to each criteria; the weight factor was based on our knowledge of the product, the target

specifications and the suggestions made by the client in the client meeting. Figure displays the decision matrix.

Decision Matrix																			
Selection Criteria	**weight**	**Juan 1**		**Juan 2**		**Juan 3**		**Nicolas 1**		**Nicolas 2**		**Nicolas 3**		**Bruce 1**		**Bruce 2**		**Bruce 3**	
Distance between Patient and remote	0.1	3	0.3	7	0.7	5	0.5	5	0.5	3	0.3	5	0.5	5	0.5	6	0.6	6	0.6
Distance between remote and TV	0.1	8	0.8	3	0.3	5	0.5	3	0.3	5	0.5	3	0.3	5	0.5	3	0.3	4	0.4
Method of signal Transmission (hard-easy)	0.1	6	0.6	3	0.3	7	0.7	5	0.5	6	0.6	6	0.6	7	0.7	4	0.4	6	0.6
Method of signal Receiving (hard-easy)	0.1	3	0.3	6	0.6	7	0.7	5	0.5	5	0.5	5	0.5	7	0.7	5	0.5	6	0.6
wireless/cable	0.05	6	0.3	4	0.2	5	0.25	5	0.25	6	0.3	7	0.35	7	0.35	2	0.1	6	0.3
size	0.02	1	0.02	1	0.02	1	0.02	1	0.02	2	0.04	1	0.02	2	0.04	1	0.02	1	0.02
Purchase Price (expensive-cheap)	0.1	2	0.2	1	0.1	1	0.1	2	0.2	1	0.1	1	0.1	6	0.6	5	0.5	5	0.5
Reliability (not reliable- very reliable)	0.1	6	0.6	7	0.7	4	0.4	5	0.5	7	0.7	3	0.3	5	0.5	7	0.7	5	0.5
Design Difficulty (hard-easy)	0.1	5	0.5	5	0.5	3	0.3	4	0.4	6	0.6	4	0.4	5	0.5	3	0.3	6	0.6
Novelty (old-new)	0.01	1	0.01	1	0.01	3	0.03	1	0.01	1	0.01	1	0.01	5	0.05	5	0.05	5	0.05
Likehood of success	0.1	6	0.6	6	0.6	5	0.5	4	0.4	7	0.7	5	0.5	5	0.5	7	0.7	2	0.2
Ease of Fabrication (hard-easy)	0.05	6	0.3	6	0.3	2	0.1	5	0.25	4	0.2	5	0.25	7	0.35	6	0.3	4	0.2
Expandable (not expandable-very expandable)	0.07	5	0.35	5	0.35	5	0.35	4	0.28	4	0.28	3	0.21	5	0.35	5	0.35	3	0.21
Total	1		4.88		4.68		4.45		4.11		4.83		4.04		5.64		4.82		4.78

Figure 5. Decision Matrix

From Figure we can see that the best three options with the highest score was the concept 1 by Juan guzman, concept 2 by Nicolas and concept 1 by Bruce.
We agree with the outcome of the matrix decision, we can also see the tasks that we can prioritize and the most challenging tasks for building the project

4. Choose one or a few promising solutions you wish to develop further based on your evaluation.

According to the decision matrix we have chosen concept 1 by Juan and concept 1 by Bruce as very promising solutions that we wish to develop.
The concept 1 by Juan describes a product that is not connected to the TV and that uses a microphone to get the voice commands from the user, then will translate the commands and transfer them via infrared to control the TV. Similarly, the concept 1 by Bruce uses a microphone to listen for the commands from the user but in this design the product is connected directly to the TV and will control the TV using the HDMI cable.

These solutions not only got the highest score in the decision matrix, but they scored very high on criteria that we consider critical, for instance; both concepts scored very high on the reliability

and likelihood to success criteria. In our opinion those two criteria are very important because we want to build a product that is very consistent, dependable and we want to make sure that we can have a finished product that will succeed.

We chose the selection criteria based on the target specifications and the decision matrix has suggested the two concepts described before, we believe that they are options that will fulfil the client needs and we will be able to have either concept finished by the end of the semester.

5. Develop a group design concept which is either an integration or modification of the promising concepts chosen in the previous step, or a brand-new concept created from these ideas. Justify your approach.

We have decided to integrate both concepts, we will aim to build a product that will integrate both functionalities: first, being able to receive and send signals wirelessly and second, receiving signals wirelessly and transferring these signals to the TV through the HDMI cable. So, we want to build a product that can execute the task either wirelessly or by being connected to the TV. We believe that this product will integrate all the needs of the client and will offer the client many types of advantages and convenience.

In conclusion we will build a product that will be always listening for voice commands from the user, once the commands are taken and translated the device can control the TV by sending control signals by either infrared methods or by being directly connected to the TV. The device can be placed next to the patient or can be left besides the TV.

6. Visually represent (sketch, diagram, CAD model, etc.) your group concept.

The following sketch shows that the voice controller will be plugged to the TV at a medium-close distance to the Patient bed.The patient will be speaking and the voice controller's antenna will pick up and recognize his/her voice to be processed into a command. This command signal will go the the TV and will trigger an action based on the command.

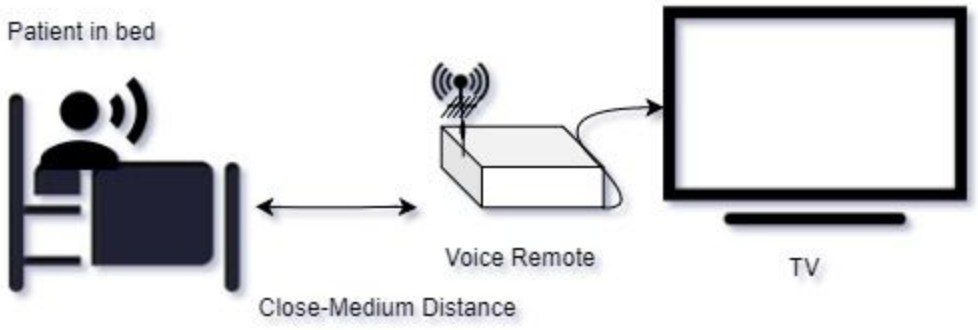

Figure 6: Group Concept Sketch

7. Provide a few lines explaining your concept's relationship to the target specifications, as well as its benefits and drawbacks.

The final concept that came out from the integration of the two concepts that scored the highest in the decision matrix will accomplish most of the target specifications. There are some specifications that we will be able to accomplish once we start building the device and start testing it. The final concept allows the user to control the TV using voice commands with no need of an internet connection, it controls any type of TV, it detects a wide range of voices and commands, it can be programmed with custom words and it is affordable.

The benefit of our final concept is that it can either send IR signals to control the TV wirelessly or it can be connected directly to the TV to control it. These two functionalities make the device not dependable on the internet. It also uses a microphone to capture the voice commands, which assures that the device will be able to listen to low frequency commands (user that speaks very low).

We believe that there are no drawbacks from our final concept but we believe that other concepts could have been more versatile and better looking, but they were either not affordable, very hard to implement and very rare to succeed.

C.2 Project Plan, BOM and Feasibility Study. Using the Project Management Workbook provided in class:

1. Develop a project plan and ensure you address each point in the workbook.

LIST	DUE DATE	TITLE	LABELS	MEMBERS	STATUS
To Do	2019/03/29	I-Design Day			OPEN
To Do	2019/03/29	I-Design Day			OPEN
To Do	2019/03/15	H-Economics Report & 1 minute Video			OPEN
To Do	2019/03/08	G- Prototype 2 & Customer FeedBack			OPEN
To Do	2019/03/01	F-Business Model			OPEN
To Do	2019/02/11	E-Project Presentation			OPEN
To Do	2019/02/08	D- Detailed Design and Prototype 1			OPEN
Completed	2019/02/01	C-Project Planning			OPEN
Task Owner	2019/01/31	Nicolas Salcedo			OPEN
Task Owner	2019/01/31	Juan GUzman			OPEN
Task Owner	2019/01/31	Sike(Bruce) Yin			OPEN
Major Tasks	**2019/02/26**	Enviroment Set-up			OPEN
Sub-Tasks	2019/02/19	Setting up python on Raspberry Pi			OPEN
Sub-Tasks	2019/02/21	Setting up Raspberry PI controller			OPEN
Sub-Tasks	2019/02/22	Set up Other hardware			OPEN
Sub-Tasks	2019/02/25	Setting up libraries in Raspberry Pi			OPEN
Sub-Tasks	2019/02/26	Setting Microphone on raspberry Pi			OPEN
Major Tasks	**2019/04/03**	Voice Recognition			OPEN
Sub-Tasks	2019/03/13	Getting signals to raspberry pi using the microphone			OPEN

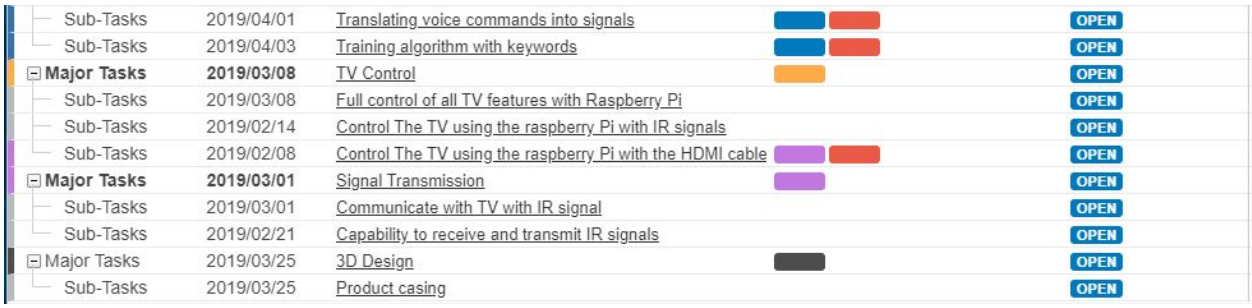

Figure 7:Project Task List

2. Provide a detailed bill of materials and parts (BOM) for each prototype, which will be presented to your project managers for approval and purchase. You will be given up to $100 for the development of your final prototype only.

Item Number	Part Name	Description	Quantity	Unit Cost	Extended Cost
1	Raspberry Pi 3	Main part of voice control remote	1	$44.88	$44.88
2	HDMI Cable	Cable that is used to connect TV	1	$11	$11
3	Wires	Make a Circuit	10	$0.2	$10
4	Microphone	Receive Voice	1	$2	$2
5	330 ohm resistors	Resistors that will be used to maintain proper current	5	$0.05	$0.25
6	NPN Transistor	Transmit signal to Raspberry pi	4	$0.96	$3.84
7	Breadboard	A board that is used to build circuit	1	$9.38	$9.38

8	IR LED	Transmit signal to TV	2	$0.41	0.82
					$82.17

3. Conduct a feasibility study by discussing the five TELOS factors. It is highly likely that you need to modify your concept or your plan later on in the design process. Therefore, it is critical that you document your ideas and processes properly.

Technical: Does your team have enough expertise and technical resources?
In order to successfully design the voice controller, it has to be taking into account the technical aspects required to build it. Therefore for voice recognition, signal processing, integrated controllers and computer programing expertise is required. Fortunately, a raspberry pi microcontroller is an excellent resource as it allows us as a team to work with received signal by writing and running computer programs in it.
Every team member has experience writing computer programs. Therefore voice recognition algorithm will be fairly challenging task. we have two team members in 5th electrical engineering and they have adept experience on handling circuitry or working with signal processing.Therefore integrating every component together with any external devices will not a difficult task on the electrical aspect.

Economic: Can the cost of your project be reasonable?
The majority of the voice controller voice recognition and signal trasmital is covered by the raspberry pi microcontroller due to the fact it has a built-in receiver/transmitter and programming scripts can be uploaded in it.Therefore spending about $50 on the raspberry pi is very efficient and fair. Secondly , sending the processed command signal to the tv through wire, it is logical that only an hdmi wire is required, thus $12 dollars is a fair price. Lastly, external circuitry and the use of microphone will be taken into consideration to optimize the accuracy of voice recognition,Therefore $15 is a fair price since the microphone , breadboard, circuit wires and other electrical components are very cheap.

Legal: Are there any legal issues with releasing your solution to the public

The Voice controller will only send commands to the TV when the patient says a specific instruction.It will not pick up any other information. Therefore the confidentiality policy in the hospital will be respected. Thus, there will not be any legal issues on releasing our design to the public.

Operational: Are there any organizational constraints that will prevent your success

The distance between the patient bed and the TV is something important to be taken into consideration. Depending on where the TV was installed in the patient room, if it is already placed at a medium-far distance from the patient's bed, the voice remote could have inaccuracies in picking up the patients voice. Also, the voice control remote is not depended on using internet; therefore, there exists problems with system updating. Picking up voice with accent is also a constraint because accent is not normally can be picked up by voice recognition system.

Scheduling: What are the deadlines and are they reasonable for your solution

There are few deadlines:

1. Detailed Design and Prototype 1, Feb 10
2. Project Presentation, Feb 11-15
3. Business Model, March 3
4. Prototype 2 & Customer Feedback, March 10
5. Economics Report & 1 Minute Video, March 17
6. Design Day, March 29

Most seems Deadlines reasonable except the Detailed Design and Prototype 1 because the time from now to the Feb 10 is short. Also the time period is co-op interview and midterm period so it is hard for teammates to gather together to finish the detailed Design and prototype. Eleven days seems a bit rush to complete the work.