WORCESTER POLYTECHNIC INSTITUTE

ECE 2799 - Habit Helper

Team 14

Homework 3 - Define Project Milestones

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1. Introduction

In this report we will outline our schedules and organizational tools that will keep our project on track for the duration of the term. We have included numerous Gantt charts for each major part of the project to give a timeline of what we have to do and when we plan to finish it. The Gantt charts are not set in stone, but they provide a detailed overview of what needs to be completed and how much time we have to do it. In order to create the most detailed schedule possible, we generated Gantt charts for each important area of the project. This provides an in depth look at the specific tasks that need to be completed. Additionally, we created a general chart with the entire project depicted from start to finish. Overall, the information and figures in this report aim to give our project structure so it is more likely to be done well and on time.

2. Top Level Gantt Charts

In this section, we will discuss both our basic top-level Gantt chart and our complete Gantt chart to summarize the key parts of our project. We will also cover any anticipated delays, and how the team plans to reconcile them.

2.1 Basic Top-Level Gantt Chart

The basic top-level Gantt chart for this project includes only the overview of the project with little to no detail. It is intended to help keep us on track and aware of the project timeline. Each of the tasks are based on the deadlines provided in the syllabus of this course, the milestones which are most important to us, and the timeline we are aiming to follow. Some unscheduled time has been allowed at the end of the timeline to allow for any unexpected delays or difficulties. We understand that the timeline will have to be kept up to date throughout the project depending on the amount of progress made.

The top-level Gantt chart for our project includes the following four main tasks.

- Homeworks
- Design
- Build
- Test

Homework assignments were included because they are an integral part of the course. The homework completion is another way to track the progress of the project since the assignments directly relate to the project. The top-level Gantt chart is shown in figure 1 below. Please note that leaders were not assigned to these tasks because a leader was assigned to each sub-task within a category.

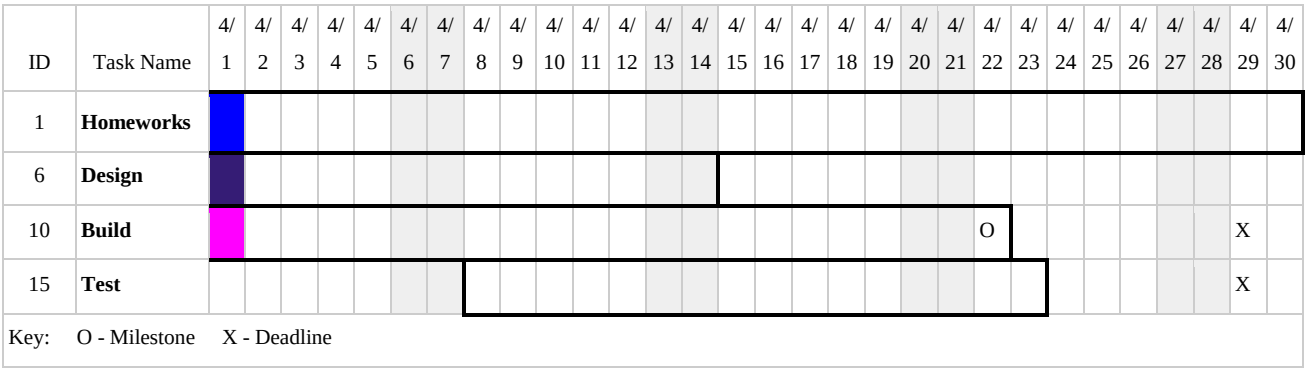

Figure 1: Basic Top-Level Gantt Chart

The milestone (denoted as O) shown in the top-level chart is the completion of the entire building process. This was listed because it is a motivating part of the process to focus on. The deadlines (denoted as X) shown are the absolute ends of building and testing. This deadline is listed because the final report and class demos are due on 4/30/19. Many deadlines and milestones are not shown in the basic top-level Gantt chart because they apply specifically to sub-tasks.

2.2 Complete Gantt Chart

In addition to a top-level Gantt chart, we also have a complete chart which shows an overview of the entire project. It includes the main tasks, sub-tasks, milestones, deadlines, and dependencies for each part of the project. The complete Gantt chart for our project is shown in figure 2 below. Please note that each of the main tasks and their sub-tasks will be broken down in detail in part 3 of this report. Part 3 will also explain why the corresponding leader was chosen for each task.

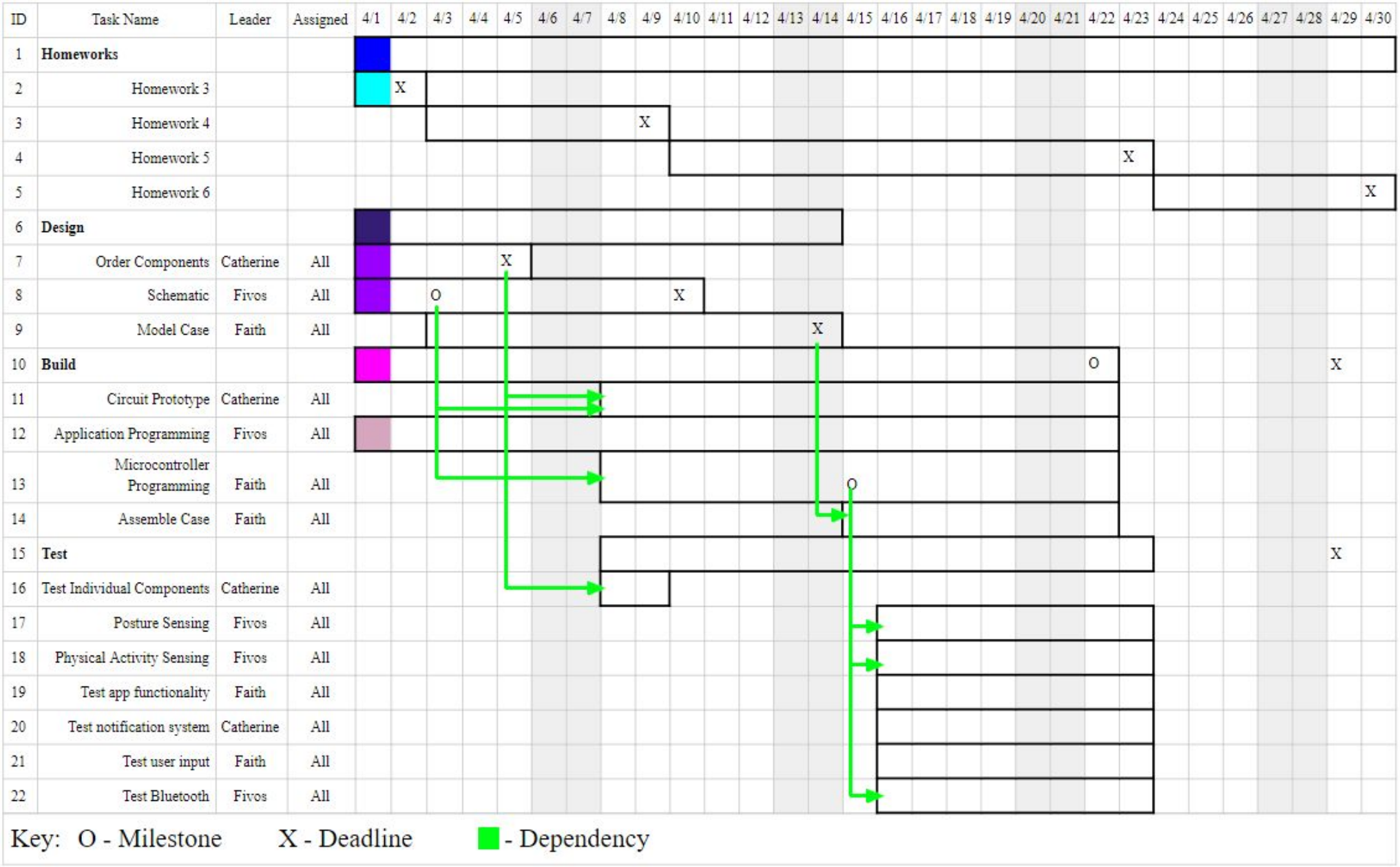

Figure 2: Complete Gantt Chart

2.3 Potential Delays and Contingency Plans

There are many parts of the project which could result in delays of the overall timeline. First, any tasks which function as prerequisites for other tasks have a high likelihood of causing delays. For example, if the schematic is not finished, we will be unable to finish programming the microcontroller. On top of this, most of the testing phase depends on having the microcontroller programmed, which means that testing would be delayed as well. To avoid such major delays in the project, the team may sometimes need to focus on the tasks which function as prerequisites over other tasks on the list. This may mean that the tasks being put off are delayed themselves, but their delay is much more manageable in the project as a whole.

Another potential source of delays is a particularly difficult or time-consuming task. A task like this may cause delays simply because it takes longer than expected to complete. For example, building the prototype is often much more difficult than expected, which causes delays for many projects. To combat this issue, the team will try to be realistic in terms of what can be achieved in the given timeframe. We will also make sure to use all available resources, especially outside expertise, in order to complete a difficult task more quickly.

Finally, many delays can be caused by things not fully in our control, such as 3D printing parts or ordering components. If we need to wait to use the printers, or if there is a shipping delay, that could set us back. We will alleviate this risk by planning ahead for delays and ordering materials/components from reputable sources hoping that they will deliver on time as promised.

3. Task-Specific Gantt Charts

The following sub-sections contain explanations and specific Gantt charts for each top-level task in our project. Each top-level task consists of several subtasks that do not appear on the general Gantt chart, but are very crucial for the completion of the project. Spelling out these tasks is important because it is very difficult to accurately estimate the time something will take only considering the overall task and not the sum of the tasks that make it up. Additionally, in this section we will assign leaders to each sub-task, based upon a team member's strengths and expertise in each area. Moreover, when assigning leadership positions, we made conscious decisions on maintaining balance and equal opportunity for each team member to experience this role sufficiently. The whole team will be working on completing the set of tasks, but the assigned

leaders will be responsible for orchestrating the team in accordance with the scheduled deadline and milestone dates. They will also be responsible for coming up with contingency plans and taking care of risk items so as to hopefully avoid any problems in the future. The information described below will give us more control over the project and will maximize the likelihood that it will be completed on time.

3.1 Homeworks

The first subsection covers homework. The goal is to keep track of when homeworks are due so we do not forget about them among all of our other tasks. Unlike the sections below, the homework section does not include leaders because it is important that everyone contributes equally. Additionally, everyone will have the same amount to write about in the reports because of how the following tasks are divided. The Gantt chart shown in figure 3 below shows the deadline for each homework set with Xs. Since the homework is due at specific times every week or two weeks, we did not budget extra time past that date to finish it.

ID	Task Name	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30
1	**Homeworks**																														
2	Homework 3		X																												
3	Homework 4									X																					
4	Homework 5																							X							
5	Homework 6																														X
Key:	X - Deadline																														

Figure 3: Homework Task Gantt Chart

3.2 Design

This subsection covers the “Design” task indicated in our general Gantt chart above. This task entails ordering the desired components for building our circuit prototype, finishing our device’s schematic and modelling the case for our product. A Gantt chart indicating this categorization is displayed in the figure below (Figure 4).

ID	Task Name	Leader	Assigned	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30
6	**Design**																																
7	Order Components	Catherine	All					X																									
8	Schematic	Fivos	All			O							X																				
9	Model Case	Faith	All														X																
Key: O - Milestone X - Deadline																																	

Figure 4: Design Task Gantt Chart

For the sub-task regarding ordering the components, we have set a deadline on April 5th since, according to the syllabus, the mass orders to Digi-Key and Mouser will be done on that date. The leader in charge for the fulfillment of this sub-task is Catherine. Once the components arrive, the dependency concerning the "Test" sub-task, namely testing the individual components, will be satisfied and thereby testing will be ready to begin.

The second sub-task of the "Design" task refers to the schematic of our device. We have set a milestone for implementing a preliminary schematic on April 3rd because we have an individual group meeting with Professor Stander at that day, in order to discuss the specifics of our design. After we receive feedback from both Professor Stander on Wednesday, April 3rd, and our Senior Engineers on Friday, April 5th and we have our desired components in our possession, we will be able to begin two sub-tasks of our "Build" task. The first sub-task is circuit prototyping, whereas the second is programming the Arduino Nano microcontroller. Furthermore, through this feedback we will eventually conclude our schematic diagram. The deadline set for the completion of this sub-task is April 10th because we will have our second design review on that date, which requires our final schematic as a deliverable. The leader assigned for this sub-task is Fivos.

The last sub-task with respect to this task is modelling our product's case. We will accomplish this by using SolidWorks to implement our case design. The deadline set for the completion of this sub-task is on April 14th. Once this deadline is met, the dependency respecting the assembly of the case will be relaxed and therefore, we will be able to start the

process of 3D printing the case, which is a sub-task of the “Build” task. The leader of this sub-task is Faith.

The biggest risk item in this task is modeling the product’s case is SolidWorks. As a team we do not have much experience with using SolidWorks and it will take time to learn the software before we can model anything with it. Additionally, we do not have any experience 3D printing using a model that was created in SolidWorks, so we would also have to do some research in this area. However, we have had some 3D printing experience using other CAD software, so translating this experience to SolidWorks should be relatively straight forward. In case learning SolidWorks on our own does not yield appropriate results, we will enlist the help of someone who is very skilled in using SolidWorks and can help us create our design.

3.3 Build

The third task on our Gantt chart is named the “Build” task and it consists of crucial sub-tasks for the development of our product. More specifically, in order for this task to be completed, we must finish making the circuit prototyping for our device, develop the phone app that will complement our product, program the microcontroller of our circuit and assemble the device’s case. The absolute deadline set for the whole task is on April 29th since we are required to bring our projects to class the next day. However, we aim to finish the “build” task a week earlier than that, thereby setting a milestone on April 22nd, in order to have more time to test whether our device is operating properly under different conditions and to generally avoid being in a position of building things at the last minute. The figure below indicates this classification in the form of a Gantt chart (Figure 5).

ID	Task Name	Leader	Assigned	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30
10	**Build**																								O							X	
11	Circuit Prototype	Catherine	All																														
12	Application Programming	Fivos	All																														
13	Microcontroller Programming	Faith	All															O															
14	Assemble Case	Faith	All																														

Key: O - Milestone X - Deadline

Figure 5: Build Task Gantt Chart

The first sub-task on the list is circuit prototyping which includes correctly connecting the battery, the microcontroller, the inertial measurement unit (IMU), the Bluetooth transceiver and the vibrating mini motor disc to create a functional system that will allow us to control its modules in order to morph our device into something that our target audience would desire. Circuit prototyping will begin on April 8th as long as the milestone and the deadline from the "Design" task are completed beforehand. The leader in charge of this sub-task is Catherine. Lastly, the absolute deadline set for the completion of circuit prototyping is April 29th, but our goal is to finish on April 22nd. This statement is also true for all of the following sub-tasks that belong in this task.

The next sub-task is developing the phone application that will accompany our device. For accomplishing this sub-task, we will establish a Bluetooth connection with our product and our phone through the app, in order to create a communication link within the two. Furthermore, we must display and parse the data sent from our device to the app to display graphs that will give visual feedback to the user. The leader for the application programming sub-task is Fivos. We started programming the application on April 1st.

The third sub-task of the "Build" task involves programming the Arduino Nano microcontroller. This sub-task entails accurately sensing for bad posture and low physical activity periodically through the IMU, enabling the vibrating motor when bad posture is sensed and processing or sending data through the Bluetooth connection between phone and device as described in our previous report. We will start programming the microcontroller on April 8th, as long as we have finalized our schematic. Furthermore, when compared to the other sub-tasks that

belong to this task, we have set an extra milestone for this sub-task on April 15th. Our goal for this milestone is to establish an initial algorithm for posture sensing, low physical activity and have Bluetooth connection between device and phone in order to test these functionalities (three dependencies satisfied for three corresponding sub-tasks of "Test" task) from April 16th and on. Testing these fundamental operations of our device will help us debug our program and re-implement it to make it more effective. The leader for this sub-task is Faith.

The final sub-task of the "Build" task concerns assembling the case we modelled in the "Design" task. The deadline for modelling the case is on April 14th, therefore the latest date that we will start assembling it is April 15th. For this sub-task, we will 3D print our case model using WPI's resources. The leader for the case assembly is Faith.

This section has the largest number of risk items and tasks that could take a lot longer than the budgeted time. The first is the circuit prototype, which itself is a minor risk, but coupled with getting that to work with the microcontroller code will probably take a while. Additionally, we do not have much experience in Bluetooth connections, so getting the physical device to reliably communicate with our app will require a fair amount of trial and error. Should these sub-tasks run longer than the allotted time we borrow more time from the testing section, as getting the product built is more critical than doing extensive testing. Additionally, if we run into a roadblock big enough that our research does not yield any answers, we will enlist the help of our senior engineers and maybe some other staff to see if they have any insights that will get the device to work.

3.4 Test

The final task on our Gantt chart is called the "Test" task. This task comprises of testing the individual components, posture sensing, physical activity sensing, the app's functionality, the notification system, the user input and the Bluetooth connection. The absolute deadline that we have set for this task is on April 29th since we can keep testing our prototype under different circumstances until the final day of the term (April 30th) if needed, which is allocated for demonstrating our final product in class. We will start doing all the sub-tasks stated above on April 16th, as long as the milestone set on April 15th on the microcontroller programming sub-task (in "Build" task) is accomplished. Meeting this milestone, will enable us to implement the dependent sub-tasks of this task, and thereby test our code based on its core functionalities,

namely posture sensing, low physical activity sensing and the Bluetooth communication between phone and device. The other three independent sub-tasks are to test or debug the phone app's functionality (e.g. user interface, correct visual feedback etc.), to test our device's notification system (i.e. vibrating motor is enabled at specific time fragments when bad posture is sensed) and to test the product's user input (i.e. the on/off switch). Although an absolute deadline is set on April 29th, we anticipate that we will complete this task by April 23rd. A Gantt chart with all the details regarding the "Test" task is displayed in the figure below (Figure 6).

ID	Task Name	Leader	Assigned	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30
15	**Test**																															X	
16	Test Individual Components	Catherine	All																														
17	Posture Sensing	Fivos	All																														
18	Physical Activity Sensing	Fivos	All																														
19	Test app functionality	Faith	All																														
20	Test notification system	Catherine	All																														
21	Test user input	Faith	All																														
22	Test Bluetooth	Fivos	All																														
Key: O - Milestone X - Deadline																																	

Figure 6: Test Task Gantt Chart

The testing phase is anticipated to be the easiest one because by this point we should have a functioning device that works relatively well. Here we will need to test to make sure there are no bugs in the design. The sub-tasks that are the riskiest here are Bluetooth testing, posture sensing, and physical activity sensing. These present the most risk because they are the most central aspects to the product. If it is discovered that they do not work correctly, fixing them will have to be addressed before the product will do what we said it was going to do. If there is a major bug in one of those three fields, we will prioritize the most important features and fix those first. This way we will at least have something to show at the end that resembles the device we set out to make.

4. Conclusion

As you can see from the numerous Gantt charts in the previous sections, we are just starting out in the process of actually building our physical product. Since we are at the very beginning of this process it appears that we are on track to perform all of the tasks we planned for ourselves within the time allotted. Of course there will definitely be times when we get behind on our milestones, but we have planned for those setbacks in section three. The contingency plans outlined in this report are tentative and are just guesses as to what problems we will encounter. Despite this, planning for problems is important because when one inevitably arises it will not be as stressful because there is time to resolve it before we get behind. On the other hand, it would be great to avoid setbacks all together and there are some efforts being made to keep our milestones on track. The Gantt charts have made it easier to not procrastinate because it disproves the allusion that we have a lot of time left before the project is due. Additionally, our schedules will keep us from spending too much time on one task and neglecting another. Overall, the organizational tools within this report aim to make it easier to finish this project on time in the smoothest, most stress-free way possible.

References

Matchware, “Creating Gantt Charts,” *Gantt.com*, Oct-2018. [Accessed: 4-Apr-2019]