Project Deliverable E: Project Schedule and Cost

Team #7
GNG 1103C
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1. Introduction

The opioid overdose emergency response device that our group is designing involves the consequences of failure such as loss of life of those depending on the product. These are the highest stakes any person can work with, and engineers often do. Since the consequences are severe, it is this group's responsibility to ensure a safe and foolproof design. It is therefore true that investing time and energy into careful and proper planning, as well as organization, is paramount to a successful engineering design process. The purpose of this document is to develop a schedule outline, project plan, possible risks and contingencies and to estimate the cost of the prototypes our group will develop.

2. Schedule Outline

First, the administrative plan will be discussed, including the schedule for the remainder of the semester, then the technicalities of the project will be discussed, including the costs and budget. **Table 1** displays the remaining course set milestones and their respective dates, as well as as their percentage of the final mark**:**

Table 1: Remaining milestones and their due dates and percentage marks. The prototypes are labeled in red.

Milestone (Deliverable)	Date	Percentage Mark
F: Prototype I and Customer Feedback	March 1, 2020	3.5%
G: Prototype II and Customer Feedback	March 8, 2020	4.2%
H: Prototype III and Customer Feedback	March 22 2020	5.25%
I: Design Day	March 26, 2020	5.25%
J: Final Project Presentations	March 20 - March 27, 2020	3.5%
K: Archive/User Manual	April 21, 2020	3.5%

To be taken into special consideration is the amount of time allocated between prototype milestones and the percentage mark assigned to them, which are important pieces of information that allow us to know how much work is expected to be demonstrated for each one. Ultimately, these milestones represent our time restrictions for this project, since there isn't a possibility of extra time being requested for any milestone due to the nature of the project. For each milestone in **Table 1**, a detailed analysis of the activities needed to be completed in order to identify their dependencies, time durations, and who the responsibilities belong to. A table will then be made of tasks required for each milestone, as well as its duration and owner, whose values will then be made into a gantt chart.

Milestone F: Prototype I and Customer Feedback, is the first approaching milstone, and the first of our planned prototypes. It is to be a prototype of the concept only, meaning it will not be a prototype of any of the technical functions of the device. In other words, it is a 3D version of our global concept, developed in the last deliverable, entitled “Project Deliverable D - Conceptual Design”. No materials will be purchased for this prototype as it is meant only to demonstrate the concept in order to get feedback about the design’s practicality. This in order to improve its look and shape, and therefore does not need to be made of the actual materials. The low percentage mark allocated to this deliverable reinforces the idea that not much time should be spent on the details of this prototype, and it is only important that we have something to put in the hands of the client to receive feedback about the concept. For this reason the budget for prototype 1 is $0. The prototype will consist of a metal case, which will be made in the makerlab, and rubber straps taken from an old wristwatch. **Table 2** displays this group’s identified tasks as well as their duration and owner for the first prototype.

Milestone G: Prototype II and Customer Feedback is the next deliverable to be due, and it is the second prototype related to a deliverable. This prototype is meant to test the most critical system, and we have identified that as the system which tests oxygen saturation levels and heart rate, then analyzes the normality of them. The only function being tested with this prototype is this subsystem, which means that all other parts, including the casing and straps, bluetooth, and so on, will not be made as part of the prototype. To be kept in mind is that the completion of this prototype is dependent on the purchase and obtaining of the necessary parts, which must be brainstormed and identified as a group before the completion of the first prototype. **Table 3** displays this group’s identified tasks as well as their duration and owner for the second prototype.

H: Prototype III and Customer Feedback is the final prototype to be completed as a deliverable, and it includes both the conceptual design which should be an improved version of what was presented for prototype I, as well as a complete functional system. The final prototype is constructed with adjustments made using the customer’s feedback from the previous prototypes and also our team’s analyses in order to reduce risk and uncertainty for the device. There will also be a set of stopping criteria created which allow the testing process to finish once the testing objectives have been met to a considerable standard. An acceptable fidelity will also be defined on the basis of the prototype’s objectives. In essence, this prototype is what is known as a comprehensive prototype that must fully work but it is not going to be a product that would be sold on the market. **Table 4** displays this group’s identified tasks as well as their duration and owner for the third prototype.

3. List of Task and Dependencies

Table 2: Prototype I Tasks, Durations, Owners.

Task ID	Task Description	Estimated Duration (days)	Owner	Depends on task ID:
1.1	Make the list of components and materials that must be approved by the PM/TA (will be required for all prototypes)	7	Abdel	None
1.2	Simplified version of the conceptual design made from the collection of house materials to create the casing of the watch	1	Yazan	None
1.3	Assembling the components and material based on the conceptual design	2	Ali	1.1, 1.2
1.4	Analyzing the prototype design	1	David	1.3
1.5	Receiving feedback from potential customers	1	Ali	1.4
1.6	Adjusting the prototype design based on the analysis and feedback	1	Bilal	1.3
1.7	Finishing the analysis of Prototype I and completing Deliverable F	2	ALL	1.5, 1.6

Table 3: Prototype II Tasks, Durations, Owners.

Task ID	Task Description	Estimated Duration (days)	Owner	Depends on task ID:
2.1	Make necessary adjustments to the subsystem from feedback of prototype 1	1	Abdel	1.6
2.2	Create a functional design, including the subsystems of the device using solidworks	1	Yazan	2.1
2.3	Using Arduino to code make the subsystem	3	Abdel	2.2
2.4	Determining the analytical behavior of the device (e.g. dimensions)	1	Bilal	2.2
2.5	Assemble the subsystem	2	All members	2.2. 1.1,
2.6	Analyze the functionality of the subsystem	1	Ali	2.5
2.7	Receive feedback from potential clients/users to improve the functionality of the device	2	David	2.5
2.8	Adjust the design based off the feedback and completing project Deliverable G	2	ALL	2.6, 2.7

Table 4: Prototype III Tasks, Durations, Owners.

Task ID	Task Description	Estimated Duration (days)	Owner	Depends on task ID:
3.1	Implementing the feedback of the client/user from prototype II into prototype III to the design	1	Abdel	1.6, 2.7
3.2	Assembly of all components to create a fully functional device	3	ALL	1.1, 3.1
3.3	Diagnostic testing of the device	1	Bilal	3.2
3.4	Final adjustments to improve success rate	2	ALL	3.3
3.5	Feedback from clients/users of the fully functioning device	1	David	3.2
3.6	Documenting the feedback received and the entirety of the test plan	2	ALL	3.5
3.7	Analyzing Prototype III and finish project Deliverable H	2	ALL	3.2, 3.5, 3.6

In addition to the three prototypes, the group decided that it is a good practice to plan ahead and performed the same process for deliverables I, J, and K. The tables for these can be seen in the appendix. Based on the data from the above tables and those in the appendix, the following gantt chart was made as a plan for the rest of the semester:

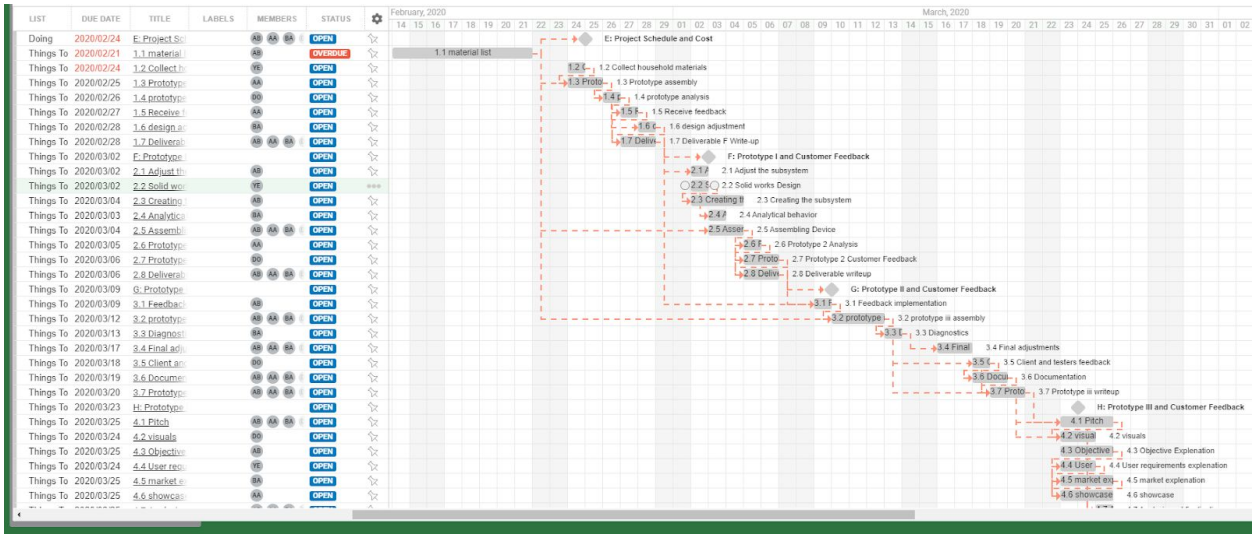

Figure 1: Gantt chart displaying project deliverables for the remainder of the semester

4. Project Risk and Contingency Plans

With any engineering project comes the potential for risks to occur. Risks can develop from any given tasks and can greatly impact a project's development including its ability to be finished in due time. **Table 5** represents a specific set of risks and their contingencies (i.e. what can be done to lessen the impact of the risk), as well as their respective risk levels (i.e. low, medium or high).

Table 5: Risks vs Contingencies

Risks	Contingency Plans	Risk Level
Insufficient battery power where it cannot supply enough current for all the components	Replace the current battery with a battery that has a higher voltage supply. This indicates that the battery will be more costly and the current budget will also have to be taken into consideration when purchasing this new item.	Medium
The circuit of the device does not function	Create a new circuit for the device and ensure that each component matches with its specific power capacity. This avoids the possibility of a short circuit.	Medium
Various parts of the design do not fit together after 3D printing the watch's casing	Make adjustments to the CAD design in Solidworks to account for the newly found dimensions of the different components	High
The change of components depending on the prototypes	Only use the most essential components first and then use the less needed components afterwards so as to not waste more time for completing the prototypes.	Low
MIT App Inventor, the web-based application used to create the GPS tracker, does not function very well (i.e. does not accurately track the user's location)	Change the code used to create the GPS tracker app and verify that the bluetooth module can maintain a strong connection with the GPS tracker	High
Arduino program does not work (i.e. code does not run)	Many things can be done including verifying that the correct ports are implemented in the code, the correct pins are used for the specific components, etc.	High

5. Estimated Projection of Costs

Table 6 represents a bill of materials (BOM for short) which is used to keep track of our team's budget for this project. The allocated amount is $100 and our team must be respectful to this budget.

Table 6: Bill of Materials

Item #	Item Description	Quantity	Unit Price	Amount
1	Vibrational Motor DC 1.3V (Bought)	5 (Minimum Quantity)	$2.878	$14.39
2	Push Button Tactile Switch (SMD) (Used from Makerlab)	2	$0.18	$0.36
3	OLED Display Module DC 3-5V (Bought)	2 (Minimum Quantity)	$4.90	$9.80
4	Sensor MAX30100 (Pulse Oximeter and Heart Rate) (Bought)	1	$11.50	$11.50
5	Arduino ESP32 Wi-Fi + Bluetooth 2-in-1 Microcontroller (Bought)	1	$13.99	$13.99
6	Arduino Mini-Breadboard Kit (Used from Makerlab)	1	$1.66	$1.66
7	Drone Charging Station with Two 3.7V Batteries (Bought)	2 (Minimum Quantity of Batteries)	$3 (Price of one battery)	$17.99
8	USB 2.0 Cable Type A/B (Used from Makerlab)	1	$3.95	$3.95

9	Rubber Straps (from an old watch)	1	$0	$0
10	10 Jumper Wires 150mm Male (Used from Makerlab)	3	$3.84	$11.52

After calculating our current budget, excluding the prices of components used from the Makerlab, it comes out to a total amount of $65.79. This calculated budget is respectful to the maximum allocated amount of $100. This gives a margin to purchase other materials in order to improve the functionality of our device if need be.

6. Conclusion

In the formulation of our teams' project plan, we have discussed the importance of many tasks which will be done by a specific team member under certain time constraints. The project plan will be closely followed using the Gantt chart produced in "Trello" however, due to the uncertainties and risk factors our plan includes, the plan is subjective to change slightly. In the event that this occurs, our contingencies will aid us in dealing with the various risk factors and limitations imposed by our device. Throughout the progression of our plan, it will be beneficial to receive consistent client/user feedback for the prototypes to come. This will greatly aid our group in meeting the end goal which is to showcase a fully functional prototype of our emergency device to the client/potential user(s).

Appendix:

The following tables are a continuation of the project plan but are separate from the actual prototyping deliverables. These tables demonstrate further planning which will be necessary after the prototyping of our device.

After the completion of the three prototypes, we must turn our focus to milestone I: Design Day. **Table 7** shows the identified tasks for the preparation of Design Day.

Table 7: Tasks, Durations, and Owners for Design Day.

Task ID	Task Description	Estimated Duration (days)	Owner	Depends on task ID:
4.1	Prepare a 2 min pitch which will be delivered to all people viewing the showcase (i.e. students, professors)	3	ALL	3.6, 3.7
4.2	Provide additional visual stimuli to showcase work (i.e. handouts, posters)	2	David	4.1
4.3	Explain the main objective (problem) that our group has solved.	3	Abdel	4.1
4.4	Explain the basic user requirements, current solutions and alternatives, and why the opioid crisis is an important problem to solve.	3	Yazan	4.1, 4.3
4.5	Explain why our design is different from others currently on the market and identify the key aspects as to why our product is better and more needed than other similar devices.	3	Bilal	4.4
4.6	Showcase a demonstration of the device and its functionality. If the device does not work, clearly explain why.	3	Ali	4.5
4.7	Analyze the product pitch and finish project Deliverable I	1	ALL	4.5

After everything is said and done, it will be time to present our solution to the client and the class for the milestone J: Final Project Presentations. **Table 8** shows the identified tasks for the preparation of the presentation.

Table 8: Tasks, Durations, and Owners for Class Presentation

Task ID	Task Description	Estimated Duration (days)	Owner	Depends on task ID:
5.1	Create a PowerPoint presentation of approx 15 mins in length, that will be displayed to the class and client	3	Abdel	3.7, 4.7
5.2	Showcase a summary of the project (from start to finish)	3	David	5.1
5.3	Display the various options to the solution that our group chose as well as why/how our chosen concept came to fruition.	2	Bilal	5.2
5.4	Explain the decisions made during the planning and development process (i.e. risks and contingencies associated with these choices)	2	Ali	5.3
5.5	Detail the trials and tribulations, valuable lessons learned, and future work.	2	Yazan	5.4
5.6	Analyze the PowerPoint presentation and finish project Deliverable J	2	ALL	5.5

The final milestone that is set is project Deliverable K: Archive/User Manual. **Table 9** shows the identified tasks to complete this document.

Table 9: Tasks, Durations, and Owners for the Archive/User Manual

Task ID	Task Description	Estimated Duration (days)	Owner	Depends on task ID:
6.1	Create title page, abstract and table of contents	5	Ali	None
6.2	Create list of figures, tables, and acronyms	2	Abdel	None
6.3	Create introduction and explain relevance of the problem, basic user requirements, and differentiations in our design compared to other devices	3	David	4.3, 4.4, 4.5, 6.1
6.4	Display the needs identification and product specification process (i.e. problem statement, benchmarking)	4	Yazan	6.3
6.5	Display the various conceptual designs	5	Bilal	1.7, 6.4
6.6	Create the project plan,display the execution of the plan, tracking & bill of materials	4	Ali	1.1, 6.5
6.7	Create an in-depth analysis of the design. This includes all formulas, calculations, data collection. This will include charts and graphs to help the reader better understand the analysis	3	Yazan	6.6
6.8	Showcase the prototyping deliverables, testing, and customer validation (feedback)	2	David	6.7
6.9	Create a clear and detailed description of the final solution and its features (i.e. talk about final testing results)	4	Bilal	6.8

6.10	Create final conclusions and recommendations for future work. This is to summarize all of the lessons learned through the work and the most productive ways that future work can be done)	2	Abdel	5.5, 6.9
6.11	Create a bibliography list. Cite all of the sources that were used in the creation of the project. (i.e. all borrowed information, whether paraphrased or cited)	4	Ali	6.10
6.12	Create appendix I: user manual. This includes the product's features, the functions and maintenance of the product, etc.	6	ALL	6.11
6.13	Create appendix II: design files. This will include all design files with explanations so that the client (or other students) next term can improve on our project if need be. The location of these files will be provided on MakerRepo.	4	ALL	6.12