University of Ottawa

GNG 1103: Engineering Design

Project Deliverable E: Project Plan and Cost

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1. Introduction

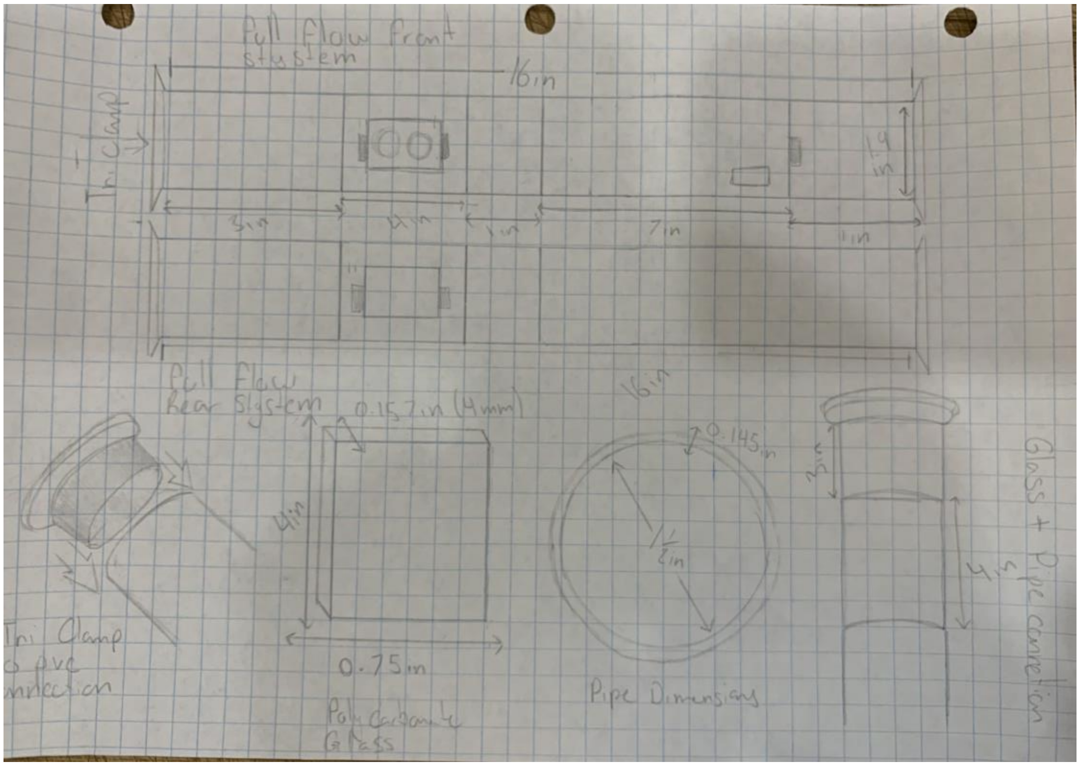
In the previous deliverables, we looked at designing a product, looking at our client needs and conceptualizing a design that would meet those needs. After an initial meeting with the client, proposing our idea, in this deliverable we aim to provide a project plan and schedule, and organize our tasks in a way which will assure we obtain a final product that meets our concept design. To do so, this deliverable will provide a detailed table with tasks assigned to their owners, as well as the time required to complete the tasks. Furthermore, an additional table will be included, presenting the risks and any potential hurdles we might encounter, to minimize time loss and maximize efficiency. Not only do are we planning the project in this deliverable, but it also provides a detailed design concept, summarizing and refining our concept. This deliverable will provide a detailed list of materials, and products required, as well as a bill of cost. The deliverable will summarize the team goals and how we plan to achieve them throughout the semester.

1. Project Plan

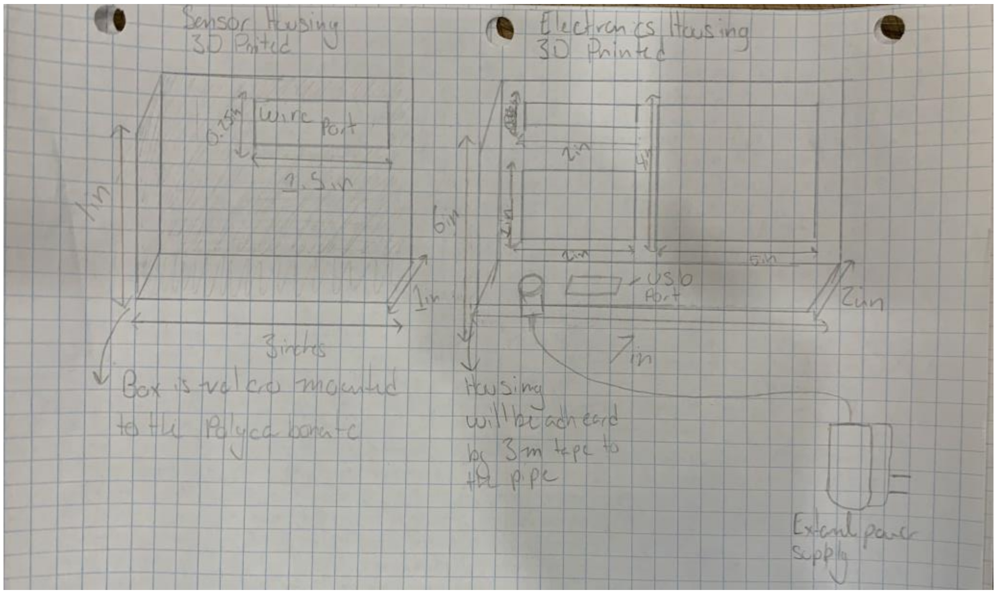
Task	Owner	Duration	Due Date
Prototype Ideation	Group	3 Days	October 26th
Prototype design and plan	Group	3 Days	October 29th
Prototype proof of concept	Group	3 Days	November 1st
Prototype design refinement	Group	3 Days	November 4th
Prototype 1	Group	2 Days	November 6th
Prototype 2	Group	7 Days	November 13th
Final design (design day)	Group	14 Days	November 27th

2. Detailed Design Drawings

2.1. Mechanical:

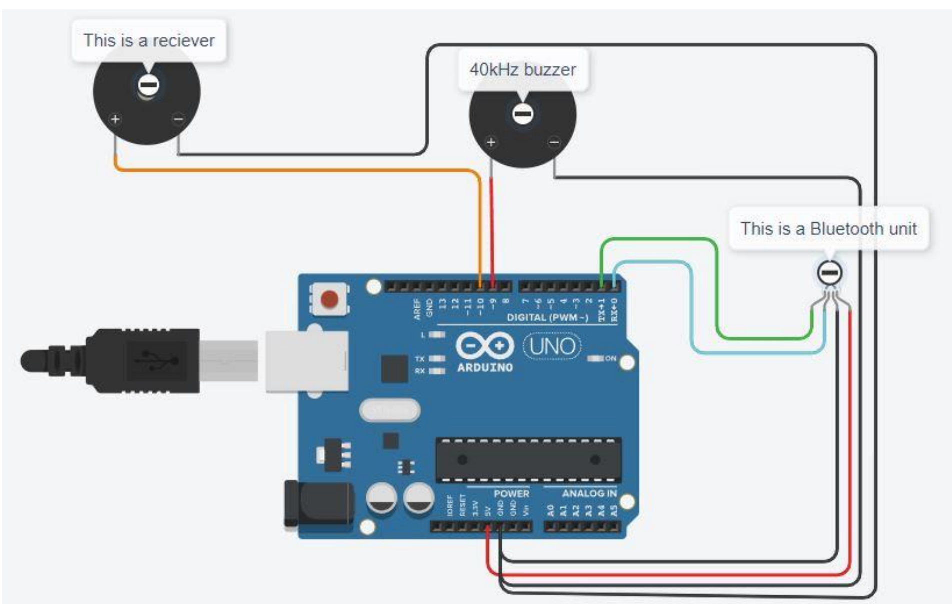


Technical Drawing 2.1.1 features the left and right views of the pipe assembly, the pipe is inlayed with a polycarbonate glass to transmit the ultrasonic frequencies through the pipe. The polycarbonate glass is adhered using a food grade silicone sealant; the tri clamp fitting is adhered using a u pvc adherent and the food grade silicone sealant. The drawing also features the housing for the sensor, in addition to the housing for the electronics. These housings will be 3D printed and held on with a 3M adhesive.



Drawing 2.1.2 features the layout of the 3D printed housings for the sensors as well as the electrical components. The housings are mounted on the surface of the pipe using a 3M adhesive, they will also feature access routings for electrical connections made between boards. The electronics housing offers a port for USB external storage, in addition to a power supply for the Arduino and components inside.

2.2. Electrical:



2.3. Software:

```
//pseudocode (yes there is already a current code that I have started making for this)

//name the pins by using variables with the same value

void setup() {
 Serial.begin(9600);
//set the pins as inputs using pinmode

}



void loop() {
  //start timer
    //send ping
    //if signal recieved, end timer
//time found is used to find speed
  //speed goes to math mathgoeshere
  //math to compare to water
  //serial print the result

}
```

3. Prototype Test Planning

Objective

The objective of this prototype 1 is that it can read the speed of the ultrasonic soundwaves through liquid, and we need to know the exact reading.

Specific demands	Reading distance	Accuracy	Water proof	Shape of the pipe	Removability (to test multiple times)
Points (1-5)	4	5	5	2	3

Specific demands

1. The ultrasonic device has to get its reading within 1.3-1.5 inch distance between the emitter and the receiver considering the emitter itself has a thickness.
2. The ultrasonic device has to get a reading that is accurate to 2 or 3 decimal places (which means it needs to be able to tell difference between water and thicker liquid) because the speed might not have an observable difference if the accuracy is deficient.
3. The whole test project can be covered with water proof material, but it has to be 100% water proof and also it cannot affect the spread of the ultrasonic wave.

4. Make sure the pipe's shape create as little echo as possible because if the echo is affecting the receiver's reading, then the outcome will create a considerable number of errors.
5. The parts of the prototype 1 has to be able to easily removed, because we will need to make a lot of changes, and if the chip or the devices are broken or damaged during the test or during the disassembly process. And we cannot use an hour or two on only assemble and disassemble during a day of testing.

Stopping criteria

1. When the reading can be read from the UPVC pipe.
2. When the reading is accurate enough to be calculated as specific gravity of the sugar water, around 35% difference will be acceptable.
3. The prototype has to have 100% water proof ability during the test.
4. The shape of the pipe which it gives the lowest error rate will be accepted.
5. Parts of the prototype should be removal in a few minutes.

4. Risks and Contingency Plans

Potential risks are a required facet of forming a plan due to the damage they can cause if they occur. Without acknowledging these risks and making contingencies to address them should action be needed, the chance of failure to complete tasks and degradation the team's ability to operate increase. Our contingencies will ensure that in the even of issues or failures we can recover and initiate damage control immediately. Some of these issues such as team members lack of cooperation have already been addressed in the team contract. Most of the risks we must concern ourselves with planning for involve the equipment and its procurement in addition to some minor risks of members being unable to complete tasks due to work overload or personal matters. Due to the nature of projects and the experimental aspects of this one. Whether it is the delivery of supplies and components or the structural durability of the design, we will attempt to consider most potential problems.

Issues with procurement:

There may be issues with our ability to procure required equipment in a timely way.

Issues with equipment:

There is a chance the equipment will fail or suffer technical issues.

Issues with assembly:

We may encounter issues in the assembly of prototypes and the final design.

Issues with funding:

Some of the chosen equipment and components are rather expensive and me be outside of our budget or limit our options.

Not enough time:

There is the possibility that we do not have the time to complete a deliverable or a task.

Member cannot complete task:

There is a risk that members will not be able to complete tasks in a timely manner or whatsoever.

Unforeseen obstacles:

There may be issues that will occur that we cannot predicted or failed to.

Categories	Chance	Impact	Contingency
Issues with procurement	high	high	attempt to find alternative methods as soon as possible and or alternative choices.
Issues with equipment	low	high	Determine if it can be repaired or if a replacement is required additionally in some cases a back up may be possible.
Issues with assembly	low	low	Attempt to find alternative designs for the construction of said prototype or design.
Issues with funding	high	moderate	We may need to find alternative solutions or be more conservative in the usage of our purchased resources.
Not enough time	moderate	high	Preferably notify the team as soon as this becomes apparent and find work arounds and dedicate emergency time to the project.
Member cannot complete task	high	moderate	Notify a member or the team itself a soon as possible and reassign the task. This may be due to external factors so preferably plan with the team for absences or lack of availability.
Unforeseen obstacles	low	moderate	Notify the team immediately and if required call an emergency meeting. This could be

			anything from sudden catastrophic failure to an unforeseen condition coming to light.

5. Bill of Materials

Table 1: Bill of Possible Materials

Part #	Part Name	Description	Cost ($)
1	Arduino Uno	Arduino UNO R3 Microcontroller	$17
2	PVC Pipe	16 in of 1 ½in uPVC pipe	$3.89
3	Wires	2 packs of jumper cables	$2
4	HC-05	Bluetooth Transmitter	$9.99
5	Plexiglass	2in x 4in x 0.5in thick	$30
6	Wires	Amazon Basics USB 2.0 Type B	$11.04
7	AC Adapter	USB Plug Power Adapter	$12.74
8	Ultrasonic Transmitter	Transmits an ultrasonic signal	$12.18
9	Ultrasonic Receiver	Detects an ultrasonic signal	$12.97
10	USB (storage)	Kingston DataTraveler Exodia 32GB USB 3.2 Flash Drive	$6.99
11	Sealant	Clear Food Grade Silicone Sealant	$17.35
12	PVC adhesive	Oatey PVC Cement, Medium, Clear	$8.49
13	3M Tape	Mounting tape	$4.98
14	Arduino IED	IED	$0
15	Arduino libraries	(Newping, SonarI2C, DueTimer)	$0
16	CodeBlocks	Secondary IED	$0
17	TinkerCad	Design software	$0
Total		(We need to cut some costs or demand	149.62

		slightly higher budget but nothing above 125$)	

6. Conclusion

In conclusion, we've planned the schedule till the last project deliverable, and we did the visualization and three-dimensional graphs for prototype 1. The electric and the program part are done with Arduino and Pseudocode, which will make it easier for our future designs to gather data from the sensor. We also finished a series of demands for test 1 for the prototype, also with risks and contingency plans for our future needs about the risks that might happen. End up with the Bill of payments which will be used to build our prototype and as an editable memo.