Final Report

ENGR 290 - Introductory Engineering Team Design Project - Fall 2022
Concordia University, Montreal QC

Instructor: Dr. Rastko Selmic - Dmitry Rozhdestvenskiy

Due: December 17th, 2022

Prepared by:
Matei Razvan Garila - 40131709
Abdoullah Ayadi - 40176086
Andre Hei Wang Law - 40175600
Hamza Sedqi - 40103843

“We certify that this submission is the original work of members of the group and meets the Faculty's Expectations of Originality”

1.0 Problem definition

Our team is tasked with designing an autonomous hovercraft which is capable of traversing a maze. We are required to design initial concepts, select one of the proposed concepts in a bias-free way (decision matrix), physically build the selected design and code its autonomous behavior with the help of the Arduino framework. The culmination of our work will be put to the test in a competition where our team's proposed design must finish a predefined maze in under 120 seconds.

The way our hovercraft is assessed if it met the given requirements is given by a formula provided to us by professor Selmic.

The formula is: $S = \frac{k * D}{T * P}$.

The "k" variable is a constant that will be used for every team providing a solution to the given problem; therefore there is nothing that our team can do to influence its value. The "D" variable is the distance the hovercraft has traveled autonomously. The "T" variable is the time the hovercraft takes to complete the maze. The "P" variable is the number of components/parts our hovercraft is composed of.

Analyzing the formula further, indicates that to obtain a high score the designed hovercraft needs to travel the entirety of the maze in the shortest time possible, under 120 seconds, with as few components.

2.0 Specification

To provide a suitable autonomous hovercraft that checks all the demands, extensive specifications must be written. Writing in-depth specifications before starting any design work should limit the possibilities of making designs that do not adhere to the rules of the competition.

The team decided to divide the specifications in two categories: demands and wishes. Demands are the rules every team must adhere to and they are non-negotiable; these demands must all be implemented to even consider the project complete/successful. Wishes are not imperatives, they are things our teams would like to accomplish, given the time constraint, that can make the process easier/produce better results.

The demands for this project are performance and materials, since they are tied to the scoring formula it is imperative that these demands are met.

Performance is directly tied to the distance the hovercraft can clear in under 120 seconds. Therefore, for the autonomous hovercraft to perform well it must have decent speed, acceleration and deceleration. Deceleration is just as important as acceleration because the hovercraft must be able to perform 180° turns; at high speeds the turning radius for any vehicle is very large. This then prompts the lift vs. friction question. The reason hovercrafts are able to move is because they have close to no friction with the ground. By increasing friction, lowering the lift of the hovercraft, it would make a great “braking” system for our hovercraft.

Materials are also tied to the scoring formula since the number of components used is multiplied to the time it takes the hovercraft to complete the maze. This is a compromise since a lower number of parts might present a more complicated coding design to implement while a greater number of parts could mean an easier code to design.

The wishes for this project are ease of manufacture and safety, although these are wishes; they are still important to consider and implement to facilitate how the project will turn out.

Ease of manufacture is a wish since for all team members this is a first when it comes to writing code for hardware that needs to accomplish a specific purpose and the odds that the first prototype works adequately are very small. Therefore, to save time, manufacturing should be relatively simple. The only demand for manufacturing comes from the rule set; it is that the diagonal of the hovercraft cannot exceed 70% of the total width of a maze corridor.

The second wish is safety. The hovercraft needs to operate safely to not injure the team or anyone else. The fans are very powerful and the lithium batteries need to be handled with special care not to cause any accidents.

3.0 Conceptual design:

Figure 1 is a sketch of the conceptual design that was selected.

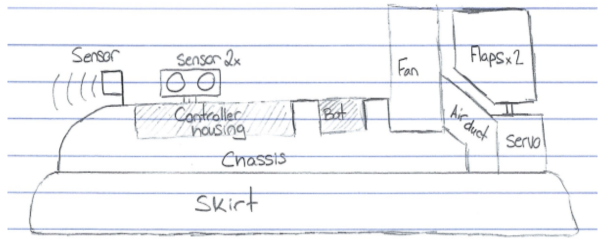

Figure 1.

3.1 System functional block diagram

The system functional block diagram which describes the interrelationships of the selected system is shown by Figure 2. Upon closer inspection, it can be concluded that there are a total of 5 components for the design. The controller and battery are not counted since the system would not work without those components.

There are 3 sensors (left, right and middle) connected to the controller for obstacle detection. The fan will serve as both the lift and thrust fan; it is also connected to the controller. The RPM of the fan would lower when needing to turn; hence increasing the friction between the hovercraft and the ground giving the hovercraft a better turning radius. The servo would be mounted behind the fan and rudders would be attached to give the hovercraft a change in direction.

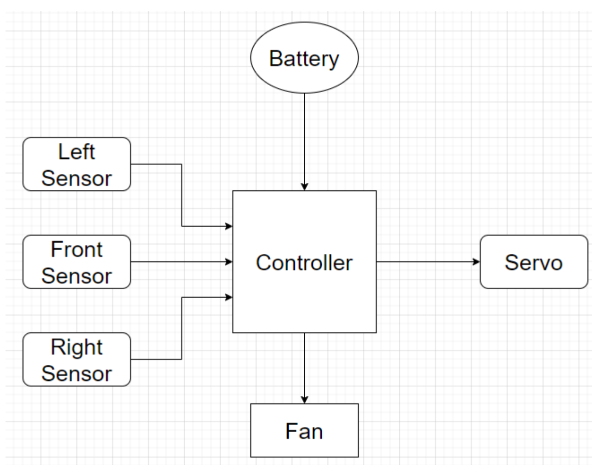

Figure 2.

3.2 Alternative designs

First Alternative Design

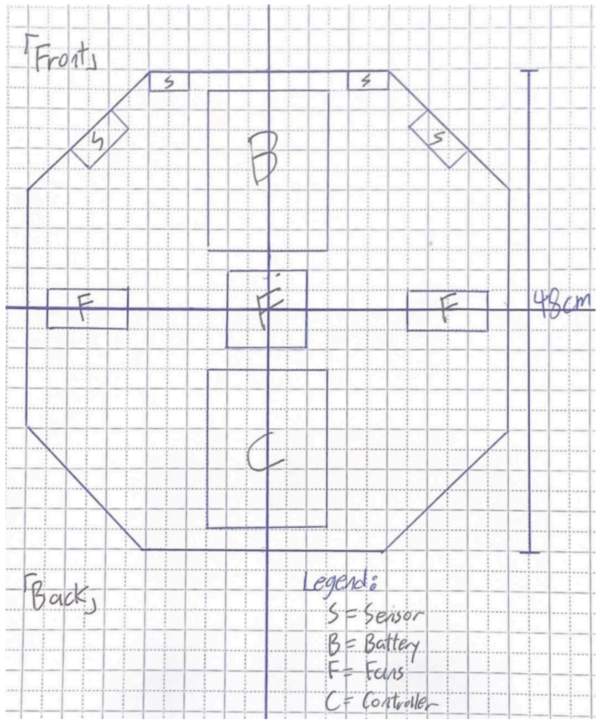

Figure 3.

Second Alternative Design

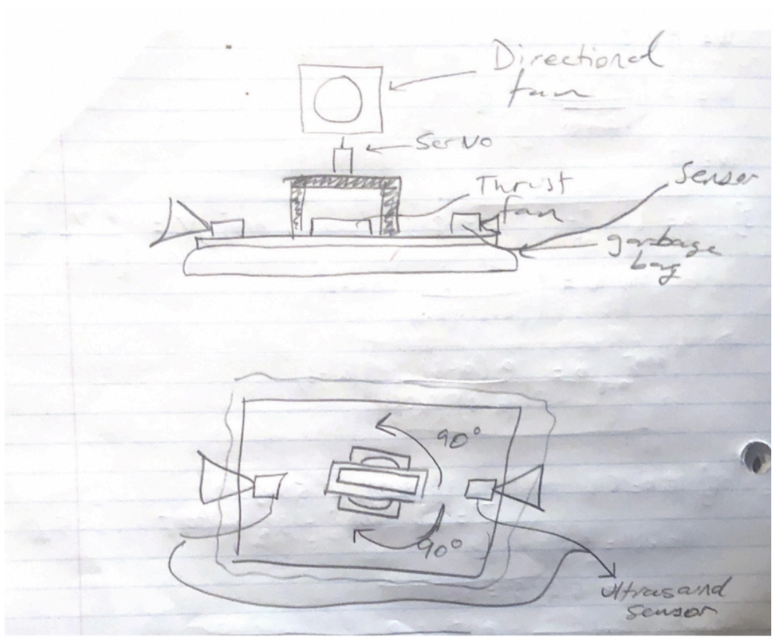

Figure 4.

Third Alternative Design

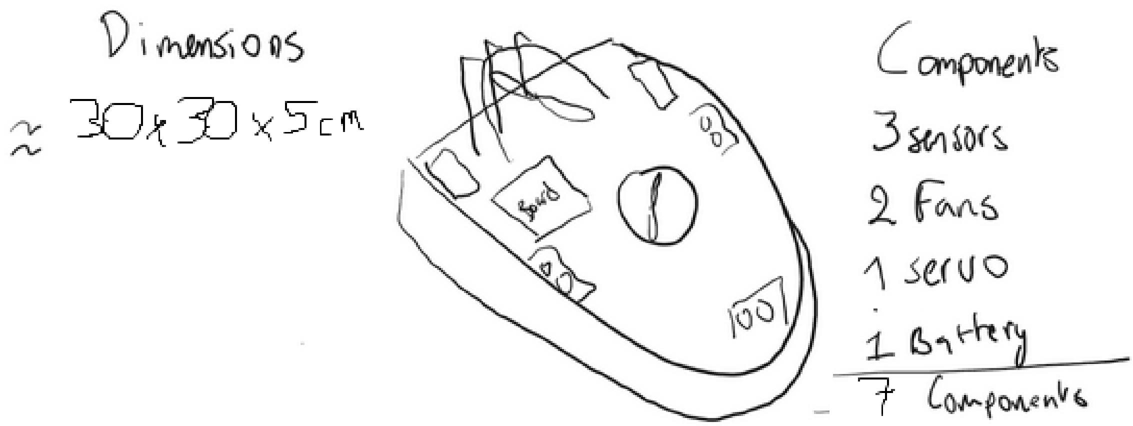

Figure 5.

3.3 Evaluation of alternatives

First Alternative Design’s Evaluation

This first rough concept prioritizes symmetry in order to maximize balance and control over the hovercraft, thus its octagonal shape. It boasts one lifting fan and two thrust fans. It has four sensors (2 US and 2 IR), the battery and the controller housing. This design was based on tanks which have no steering mechanism found in traditional cars, but rather a pair of treks that is responsible for turning. This is represented in the two thrust fans located on the side. The main disadvantage of this design lies in its fundamentals compared to a real tank, the hovercraft’s turning motion will lead to many uncertainties as the hovercraft is hovering. More precisely, the turning arc is highly dubious since it doesn’t boast heavy treks that ensures its solid grip to the ground like a tank does, allowing it to make sharp turns. Another disadvantage of this design is its redundancies in sensors. We realized that two is the minimum amount for a functioning hovercraft.

Second Alternative Design’s Evaluation

The hovercraft's stability and maneuverability are the major goals of its design. We will attempt to adjust the hovercraft's placement by employing two sensors (front and back), preventing risky movements and unwanted rotation. In this concept, two fans will be used, one to elevate the hovercraft and the other to change the direction of our travel by being coupled to a servo motor. Two batteries are employed as the power source to give each component enough power. This prototype has the largest portion of its weight focused in the center, which makes it simple for us to balance the entire construction, which is a significant advantage. The hovercraft was given a square-shape to travel more easily when coming into contact with walls.

Third Alternative Design’s Evaluation

This design has been designed so that it can be as small as possible and have as few components as possible. This is made up of a battery, a servo motor, 2 fans (Lift and thrust) and a sensor, for a total of 7 components. A plastic bag is used to make the squirt. As mentioned, the advantage of this design is that there are few components. On the other hand, the fact that it is very small means that there is not enough space to put all the components. The only solution would be to put the components one on top of the other. However, the Hovercraft will be unbalanced and it won’t go straight. Another disadvantage of this Hovercraft is that it will be difficult to make it turn in the maze without touching the walls.

3.4 Selection of a concept, decision matrix

After each team member submitted a concept to be approved, the team gathered to present their concepts. To keep the decision process equitable, it was decided that each team member would only grade the concepts proposed by the other members of the team and not their own proposed design. To achieve unanimous consensus the team agreed to utilize a decision matrix.

It was convened that four criterions with different weight would be adopted and the concept with the highest score would be selected. The criterions were taken from the specifications which allowed our team to remain focused on the goal ahead. The four criterions are: performance (weight 5/10), materials used (weight 2/10), manufacture (weight 2/10) and safety (weight 1/10). The performance criteria is based on the concept's designer's capability to explain how the concept would perform during its final stage. Since the explanation is purely theoretical at the presentation stage, each team member was invited to ask many questions to the designer of the design to make sure everything was well thought out in advance before selecting a particular concept and allocating development time.

	Matei's design	Andre's design	Hamza's design	Abdoullah's design
Total points	101	74	76	73
Points w/ weight	244	190	200	195
Avg points	34	257	25	24
Avg points w/ weight	81	63	67	65

Analyzing the results obtained from the decision matrix, it is evident that Matei's proposed design is the one to be selected. With 101 total points (34 avg.) and 244 points (81 avg.), factoring the weight of each criterions, it surpassed the scores for the other three concepts. The concept design with the closest score was Hamza's design, being 25 total points behind or 44 weighted points behind.

Figures 6,7,8 are the sketches of the selected concept.

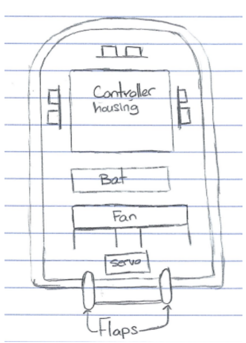

Figure 6.

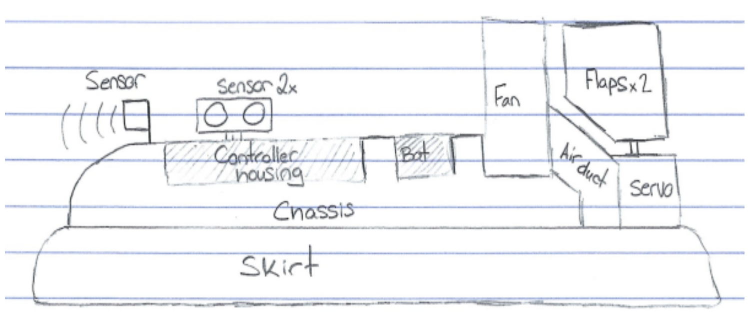

Figure 7.

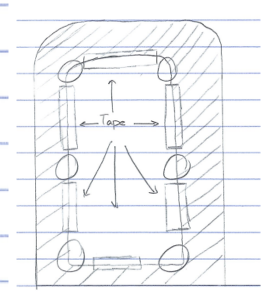

Figure 8.

3.5 Design calculations, simulations

Lift: A major concern of a functioning hovercraft lies in its capability to lift itself. Meaning, what is its lifting potential in contrast to its weight. The components that can affect the weight are the MEC0251V1 (162g), the Rhino 360 (28.5g), the controller board (200g), the sensors, the main chassis, the skirt, as well as the many minor components such as tape, hot glue and wires. To be on the safer side, we overestimated the hovercraft to be 1kg. As for its dimensions, it is 40 cm by 18 cm, making its perimeter 116 cm. Given the above information as well as the fan's datasheet, we are able to calculate its lifting height such as the following:

<u>Variables:</u>
Perimeter, l = 18 + 18 + 40 + 40 = 116cm = 1.16m
Pressure, Δp= 9.81/(0.4*0.18) = 136.25 Pascal
Air Density, p = 1.18 kg/m^3
Airflow, Q = 108.2 CFM (3.03m³/min)

$$Lifting\ Height = h = \frac{Q}{l}\sqrt{\frac{p}{2\Delta p}} = \frac{3.03/60}{1.16}\sqrt{\frac{1.18}{2 * 136.25}} \approx 2.9mm$$

Center of Mass: The formula of center of mass is the sum of products of its mass and position divided by the total mass. Since our hovercraft is a rectangular design and all components are symmetric on the x axis, the center of mass of x is the middle. In other words, it is half the width which is 18cm/2= 9cm. As for the center of mass of y, it is calculated to be y = 18 cm, which means that the hovercraft will be "back heavy". This makes logical sense as the rear has the fan, the flaps and the servo while the front only has the controller board. While the structure of the hovercraft may be symmetric and fairly balanced, an even more major contender for unbalancing the hovercraft is the skirt. More precisely, it is very difficult to precisely allow the same amount of "bloat" on all four sides. Sometimes, one side of the skirt doesn't expand as much as the rest, resulting in a tilt. As such, even if ideally, the hovercraft is balanced in terms of center of mass, it can still be overall unbalanced due to other factors which need to be solved as we build the hovercraft.

$$x = \sum \frac{x_i m}{M}$$

$$y = \sum \frac{y_i m}{M}$$

Power Consumption: Being able to provide enough power to navigate a particular path or maze is crucial when creating an autonomous hovercraft.
With regard to this particular design and all the parts we were given, we discovered that the Rhino 460 2S 20C series will supply enough power for the competition's whole course.

The following are the power consumptions of all components individually:

Name of the component	Number of pcs used	Power consumption
MEC0251V1-000U-A99	1	~5.18W
Servo motor HS-311	1	~0.9W
Arduino + board	1	~0.095W
Us sensors	3	~0.075W

The total power consumption turns out to be: 6.25W

Batteries used:

Rhino 460 2S 20C

Capacity : 460mAh
Constant discharge: 20C
Burst rate: 30C (15 sec)
Configuration : 2S 7.4v
Pack size: 52x30x8mm
Weight : 28.5g

Figure 9.

Given the above-mentioned specifications, we can estimate our power supply time to be 63 minutes, which indicates we will have enough energy to run our hovercraft for an hour.

4.0 Detailed design

4.1 Main features and how they work

As mentioned, our goal was for the hovercraft to finish the maze in under 2 minutes. We knew in advance that one of the biggest problems would be to make the hovercraft turn right and left. To avoid this problem, we decided to make a square shaped hovercraft which will always keep the same orientation. This design needed only 7 components: Two fans (Lift and thrust), two sensors (front and right), two batteries and one servo motor.

The operations of this hovercraft are very simple. We placed a sensor in front and another on the right, and according to the distances obtained, the hovercraft had to make a decision and turn the servo motor accordingly.

To code the hovercraft, we had to take into consideration 4 possible positions of the hovercraft in the maze:

Position 1: Front sensor distance is more than **X** cm, and right sensor distance is less than **Y** cm. The hovercraft will go straight.

Position 2: Front sensor distance is less than **X** cm, and right sensor distance is more than **Y** cm. The hovercraft will go right.

Position 3: Front sensor distance is less than **X** cm, and right sensor distance is less than **Y** cm. The hovercraft will go down.

Position 4: Front sensor distance is more than **X** cm, and right sensor distance is more than **Y** cm. The hovercraft will go straight.

We can see the four positions in **Figure 1** and the code logic in **Figure 2**

X and **Y** are values that were determined after doing some tests. In this case X = 10 cm and Y = 30 cm

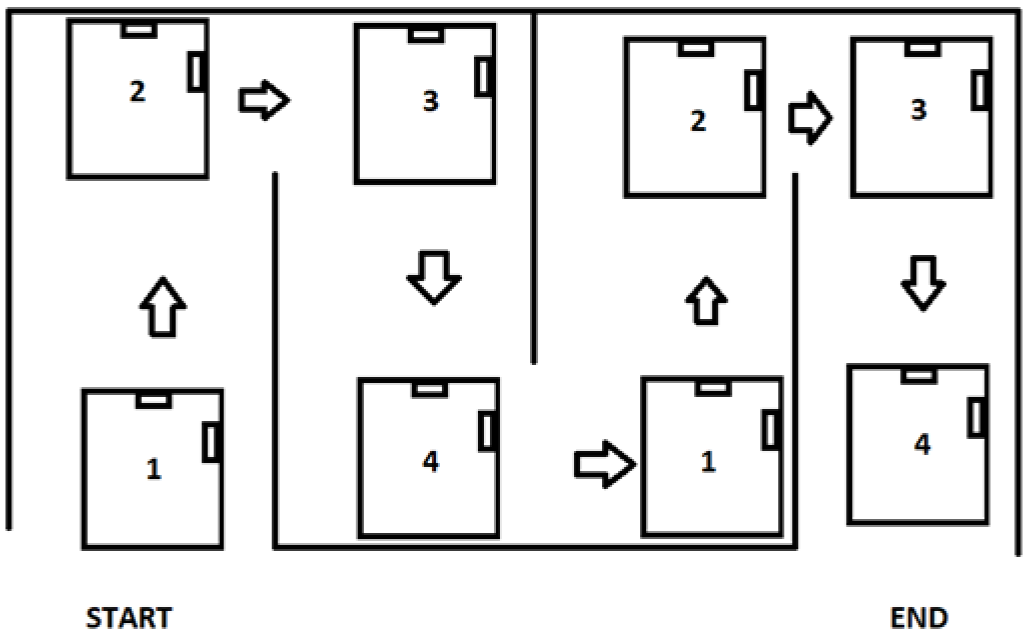

Figure 10: Hovercraft positions

```
if (front_sensor_distance > 10 && right_sensor_distance < 30) {  // Position 1

   wait(1500);
   servo.write(7);
   digitalWrite(THRUST_FAN_PIN, HIGH); // Thrust fan ON


}else if(front_sensor_distance < 10 && right_sensor_distance > 30){ // Position 2

   wait(1500);
   servo.write(90);
   digitalWrite(THRUST_FAN_PIN, HIGH); // Thrust fan ON

}else if (front_sensor_distance < 10 && right_sensor_distance < 30){ // Position 3

   wait(1500);
   servo.write(173);
   digitalWrite(THRUST_FAN_PIN, HIGH); // Thrust fan ON
   while(right_sensor_distance < 30){
     right_sensor_distance = right_sensor.Distance();
     front_sensor_distance = front_sensor.Distance();
   }
}else if (front_sensor_distance > 10 && right_sensor_distance > 30){ // Position 4

   wait(1500);
   servo.write(90);
   digitalWrite(THRUST_FAN_PIN, HIGH); // Thrust fan ON

}
```

Figure 11:Code for the positions

Important: In the third if statement, we added a while loop to make sure the hovercraft will go from Position 3 to Position 4. Otherwise, it would execute the code of Position 1.

To sum up, the hovercraft will start by turning on both fans, go straight until it reaches position 2, turn right until position 3, down to position 4 and turn right. At the end of position 4, the hovercraft is back to position 1, and will repeat the same steps until it gets to the end of the maze.

4.2 Result of analysis, experiments and models

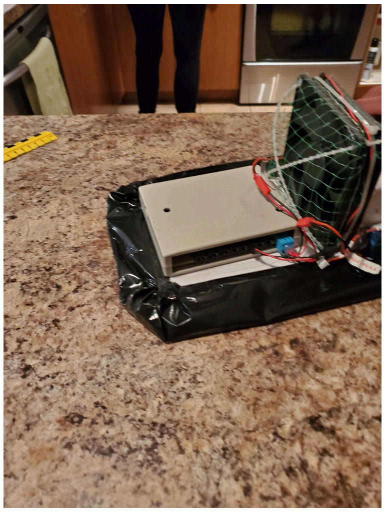

Figure 12

Figure 13

Very early in the building phase we realized that the chosen design in the section “3.0 Conceptual Design” will be very difficult to implement. One of the reasons is that the hovercraft has difficulties lifting itself. This is partially due to its small surface area chassis as well as the fact that we are only using 50% of one fan for lift. Matei has tried enlarging the surface of the chassis and he has tried remaking the skirt (larger and smaller volume). We came to the conclusion that 50% of one MEC fan simply isn’t effective at lifting the hovercraft while the other 50% is being utilized for thrust. Overall, the initial concept design has to be redesigned.

Knowing that our chosen design won’t work, we have opted to modify the design by using two fans, one for lift and one for thrust while keeping the same essence of our first design of using rudders and three sensors. While we have seen success of the hovercraft lifting itself as well as propulsing forward, we encountered many other issues. For example, whenever it has contact with the wall, it either gets stuck to it or it changes orientations. Another problem is when turning, it is very difficult to determine the arc of the turn so that it is consistent every time (i nour case, sometimes it did a proper turn, sometimes it hit the side wall, sometimes it didn’t have enough space to complete the turn).

After spending many days rebuilding and rethinking possible solutions through software and hardware, we decided to retrace our steps and try out the second alternative design from section “3.2 Alternative Designs”. This is a square design where all of its components are placed near the center (lift fan, controller board, servo motor, thrust fan and 2 small battery packs). By design, this hovercraft is already well balanced in which the center of mass is situated in the middle, namely x = 15.5cm and y = 15.5cm. This hovercraft also solves the issues of hitting walls as it is designed to move alongside the walls. Having tested an early prototype of this square design, we have decided to abandon the old design and continue to progress in this direction.

4.3 Manufacturing results, including photos

The design for the final prototype is a 31cm by 31cm square. During the initial prototypes the team noticed that a larger chassis hovered better than smaller frame chassis. Therefore the team agreed that it would be best to maximize the size of the build. Since the diagonal of the hovercraft cannot exceed 70% of the width of a maze lane (65cm * 0.7 = 45.5cm) the final prototype respects that constraint with some room to spare.

Diagonal = sqrt($31^2 + 31^2$) = sqrt(1922) = 43.84cm → 45.5 - 43.84 = 1.66cm

The following figure 14 is a top down view of the final prototype as stated previously; each edge of the build is 31cm for a 43.84cm diagonal.

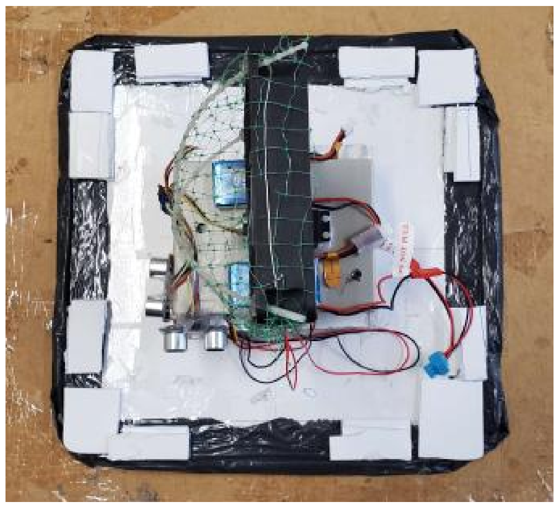

Figure 14.

During initial prototype testing it was discovered that weight management would play a crucial role in how the build would perform. If the weight was unbalanced it would cause the build to lean in that direction. Another issue the team faced concerning the build was the fact that no matter if the servo/fan combo was placed in “front” or “back” of the hovercraft, the moment that it hit a wall it would be close to impossible for the build to get itself unstuck. Due to those two issues, the team convened that it would be simpler to place all of the components in the middle of the hovercraft to assure the most even weight distribution. With the servo/fan combo being in the middle of the hovercraft it also allows the hovercraft to get itself unstuck from walls. To achieve the concept of the build a cover for the lift fan must be constructed to be able to stack all the components on top of it. Figure 15 has a better angle showing the cover.

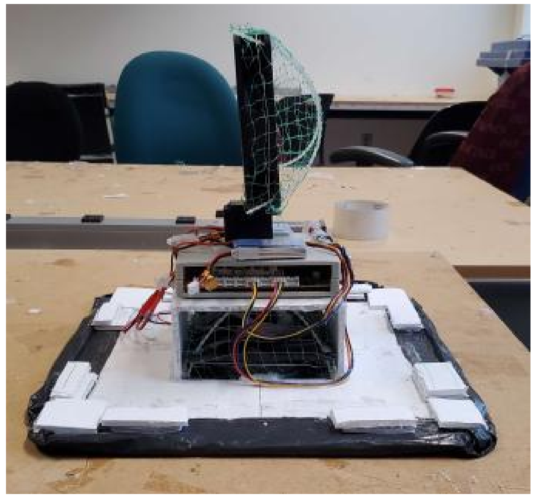

Figure 15.

The skirt posed another building challenge. When the lift fan is turned on, this skirt creates a pocket that traps the pressurized air. That pressurized air is what gives the lift to make a hovercraft work. From the team's testing, it is the component that made or broke the design. If the opening was too small then the skirt would over-inflate and the slightest weight shift would cause the hovercraft to be unbalanced. If the hole was large, then the hovercraft would not hover off the ground. Finding that sweet spot of opening became crucial to a well hovering craft.

Figure 16.

After experimenting with different skirt dimensions, we discovered that the secret to designing an effective one is to have the majority of the skirt surface hanging towards the bottom of the craft. In order to ensure that the majority of the pressured air passes through the hole and makes it simple to hover and balance, we additionally hot-glued the skirt's edges to the square board (the hovercraft's body). The skirt matches the chassis of the hovercraft being 43.75cm by 43.75cm. The opening is 15 cm by 12cm matching the skirt. These combinations were determined to be this hovercraft's ideal measurements.

4.4 Gantt chart

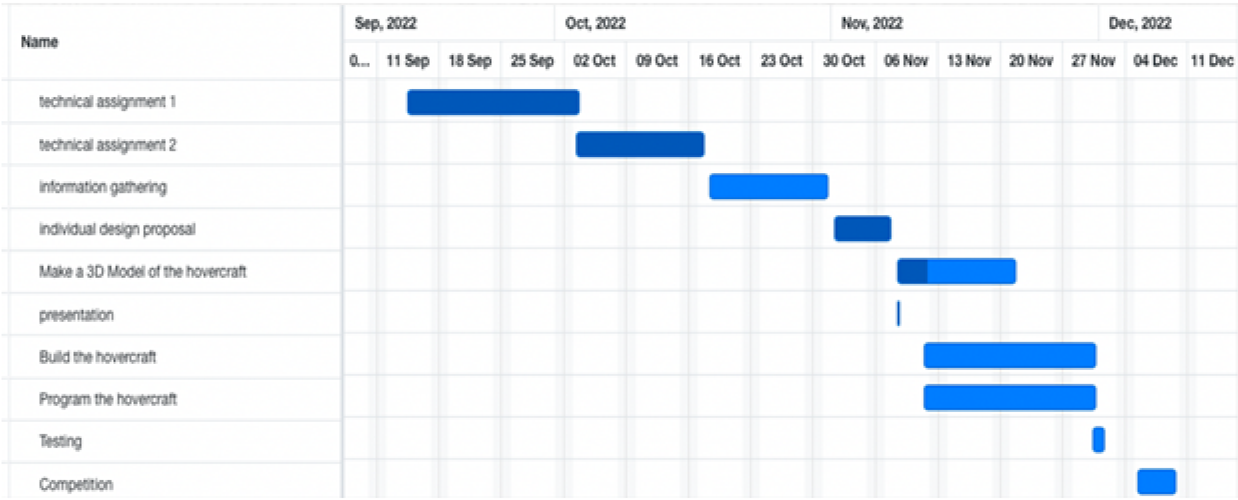

Figure 17.

We started this project by doing the assignments. These assignments allowed us to familiarize ourselves with the components: Sensors, Servo motor and IMU. Afterwards, everyone on the team did their research to learn how to build a hovercraft. We then presented our design to the teacher. For the rest of the time we had, we built several hovercrafts and selected the best one. At the same time, we worked on the code. Finally, we did several tests on the maze until the day of the competition

5.0 Performance evaluation

Performance during practice runs

We began the testing process after completing the construction of our final hovercraft prototype and ensuring that all requirements were met and our design was properly implemented.

We will divide our performance evaluation into two distinct phases, a controlled environment phase and a real environment phase, in order to make it more effective.

Controlled environment:

Our goal throughout this phase of testing was to evaluate the hovercraft's fundamental capabilities. First, we checked that the information our sensors were sending to our board was correct and that they were able to detect barriers in a variety of situations. Then, we modified the strength of the lifting and directional fans to give us enough lift and stability to travel in various directions.

After ensuring that the fundamental features operated properly in isolation, we began testing them all simultaneously by having our hovercraft navigate a straightforward maze and making a single turn to the left or the right.

Our hovercraft was able to travel 1,5 meters on a straight course in 6 seconds, averaging a speed of 0.9 km/h, which we felt is excellent for this project because we intend to go smoothly from one point to another.We had to change our skirt because it was ruined after doing many forward path tests and maneuvers in the lab.

Real environment:

It was time for us to begin the real environment phase, where we took our finished hovercraft build to the competition circuit and started doing different testings, after finishing all the primary tests on our prototype. Our hovercraft initially succeeded in navigating the maze after two attempts, taking about 43 seconds. Unfortunately, we were not prepared for the hovercraft to complete the maze in just two attempts, thus we were unable to record it on camera. In order to capture a video of the hovercraft completing the maze in 1 minute and 35 seconds, we had to conduct 6 other tryouts. This resulted in a pretty good time considering the quantity of sensors and components we used.

Performance during competition

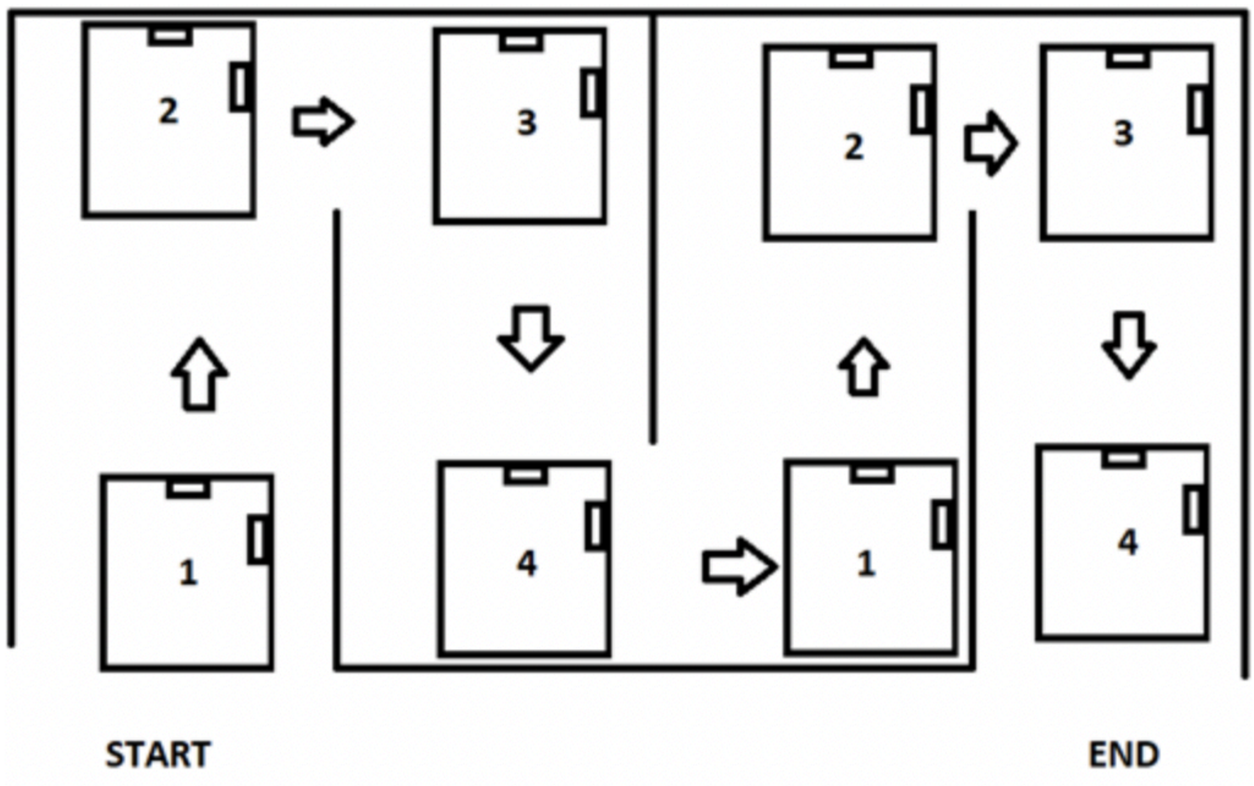

Figure 18.

Things didn't exactly go as we had anticipated during the competition day. Our hovercraft successfully completed 2 turns on its initial attempt, but after that it kept going back and forth and over itself when the sensors picked up hazardous data.

Things improved slightly on our second try, when we were able to make three turns without incident, but the prototype's position was later changed as a result of it colliding with the maze's walls.

Overall, we as a team are proud of the work we accomplished to construct an autonomous hovercraft. Even though we were unable to cross the finish line, we feel that we made the most of the resources that were presented to us.

6.0 Conclusions and lessons learned

Matei's conclusions and lessons learned

This project marked my first attempt at combining software and hardware together. I knew that my extensive background in programming alone is not sufficient to conduct this project to its successful completion. Throughout the course of the project I realized that combining hardware (the hovercraft and the components our team selected) and software posed a greater challenge than initially anticipated. For a build as tricky as a hovercraft, a slight change in the build/components (themselves and how they are placed) has great ramifications on the software. The hovercraft was a great first introduction to a real life engineering application combining hardware and software for a specific task. Applying theory into a "real life" product was difficult with a lot of try-and-error, but ultimately rewarding.

Hamza's conclusions and lessons learned

This project's endeavor to integrate all of the acquired knowledge in both the software and hardware domains is what I found to be really appealing. As a student of electrical engineering, I was impressed by how well-written code might improve the general performance of a construct like a hovercraft. I discovered how challenging it is to put all the theoretical concepts I had for this project into practise during the building phase, and I also learnt that I should always make sure to make the most of the resources I am given. Overall, I find ENGR 290 to be a very interesting class that is both demanding and engaging.

Andre's conclusions and lessons learned

In this project, I've researched, done preliminary designs, worked on the code for assignments, built the hovercraft as well as tested it extensively. However, in this entire process, the most arduous step was definitely during the building phase. I've uncovered problems upon problems such as the balancing, it getting stuck with the walls, it not moving onwards due to the slight slope of the floor, etc. However, this was also the phase in which I've learnt the most as it was required of me to be creative with my solutions, whether it was through software or hardware. The gap to bridge theory and practice is heavily dependent on your preparedness, your creativity and your problem analysis. Over, the course Engr 290 is definitely an eye opener which will prove to be useful in the upcoming capstone project.

Abdoullah's conclusions and lessons learned

I learned a lot during this project. First, I learned how to use and program an Arduino. I also learned to use several electrical components, such as the IMU, the servo motor and the sensors. In summary, this project allowed me to learn a lot of things which I think will be very useful in other projects.

7.0 References

The initial concept was based upon these videos by Tom Stanton:

"Mini 3D Printed Hovercraft." *YouTube,* uploaded by Tom Stanton, 2 Mar. 2018, www.youtube.com/watch?v=mpqYIHTIXtA&t=639s.

"RC Hovercraft Development." *YouTube,* uploaded by Tom Stanton, 9 Mar. 2018, www.youtube.com/watch?v=mpqYIHTIXtA&t=639s.

8.0 Appendix

Workshop Time:

	21/ 11	22/ 11	23/ 11	24/ 11	25/ 11	26/ 11	27/ 11	28/ 11	29/ 11	30/ 11	31/ 11	01/ 12	02/ 12	03/ 12	04/ 12
Matei		O		O					O		O	O			
Abdoullah			O		O			O	O					O	O
Andre		O		O	O					O	O	O			
Hamza		O	O		O			O	O					O	O

Your Work (who, what, when, etc.):

	Hovercraft Construction	General
Matei	-Chassis -Fans Assembly	-Leader -Document Time Meeting -Conceptual Design Research
Abdoullah	-Chassis -Hovercraft Balance Testing	-Code -3D Print
Andre	-Sensors and Battery Assembly -Hovercraft Balance Testing	-Code -Design Calculations
Hamza	-Skirt -Servo to Fan Assembly	-Hovercraft Testing -Design Calculations

Total Person Hours Worked:

	Hovercraft Construction (Workshop Time)	General (total hours dedicated to other tasks)
Matei	~27h	~15h
Abdoullah	~29h	~13h

Andre	~37h	~15h
Hamza	~28h	~17h

Meeting Minutes:

Meeting Minutes - 2022/09/21

Introductions and initial discussions

Planned start: 2100
Actual start: 2103
Planned duration: 0015
Actual duration: 0022
End time: 2125

Meeting leader: Andre Hei Wang Law - 40175600
Meeting secretary: Matei Razvan Garila - 40131709
Participants: Hamza Sedqi - 40103843
Abdoullah Ayadi - 40176086
Absences:

Topics to be discussed:

- Introductions of team members with a little about their background
- Technical Assignment 1

What was agreed upon:

- Matei will write the request for the sensors and board and go get them to be tested during the weekend.

Meeting Minutes - 2022/09/25

Technical Assignment 1

Planned start: 2100
Actual start: 2105
Planned duration: 0015
End time: 2210
Actual duration: 0105

Meeting leader: Matei Razvan Garila - 40131709
Meeting secretary: Andre Hei Wang Law - 40175600
Participants: Hamza Sedqi - 40103843
Abdoullah Ayadi-40176086
Absences:

Topics to be discussed:

- Assignment 1 dividing responsibilities
- Conversing about the relation between the arduino nano and the PCB.

What was agreed upon:

- Abdoullah and Andre are responsible for writing the code for the sensors.
- Matei will be responsible for testing the code on the board and will collaborate with Hamza on writing the report.
- Hamza will be responsible for writing the report.

Meeting Minutes - 2022/10/09

Technical Assignment 2

Planned start: 2100
Actual start: 2005
Planned duration: 0030
End time: 2045
Actual duration: 0040

Meeting leader: Abdoullah Ayadi-40176086
Meeting secretary: Matei Razvan Garila - 40131709
Participants: Hamza Sedqi - 4010384

Andre Hei Wang Law - 40175600

Absences:

Topics to be discussed:

- Assignment 2 dividing responsibilities
- Find and download the datasheet for IMU.
- Connect to the controller:
    - IMU;
    - Servo-motor (plug and play).
- Write the code that:
    - Controls the servo-motor based on the yaw of IMU:
        - the servo motor's arm should replicate the IMU yaw in the range of ±90 degrees;
        - it should not attempt to move further if the IMU's yaw exceeds ±90 degree range.
    - Turn ON LED "L" when the IMU yaw reading is outside of the ±90 degree range.
    - Control D3's brightness within ±1.00g in X-axis only:
        - D3 should be OFF when X-axis acceleration <|0.01|g;
        - D3 should be 100% ON when X-axis acceleration >|1.00|g;
        - D3 should change the brightness linearly between those two points.
    - Outputs actual roll, pitch and yaw, and XYZ acceleration values on the screen once per second.

What was agreed upon:

- Matei/Hamza will do some research and start figuring out the IMU
- Abdoullah will work on the servo motor
- Andre is on stand-by until the 14th
- Matei will get the materials wednesday

Meeting Minutes - 2022/11/03

Presentation

Planned start: 1615
Actual start: 1650
Planned duration: 0015
End time: 1730
Actual duration:0040

Meeting leader: Hamza Sedqi - 40103843

Meeting secretary: Abdoullah Ayadi-40176086
Participants:
Matei Razvan Garila - 40131709
Andre Hei Wang Law - 40175600
Absences:

Topics to be discussed:

- Dividing work each member does for the presentation
- Thinking of a design for our hovercraft (we should each come up with a design)

What was agreed upon:

- Each member will create a concept to be presented to the rest of the team
- Each member will have 5 mins to present their design
- Each concept will be evaluated by the other members upon predetermined criterias

Andre
-Title (Wtv)
-Outline of the presentation (Wtv)
-Problem definition (Wtv)
-Specifications
-(Performance, Materials, Manufacture (Gantt), Safety)

Everyone
-Sketches, system functional block diagram
-(Our drawing = Sketch/Shape of hovercraft)
-(Block diagram = Elec components, which parts you are using, etc.)

Matei
-Decision matrix
"Create the matrix that decides (objectively) which concept is the best"

Gotta ask the professor
-Design calculations, simulations \

Losers - To be decided on Saturday
-Concepts that were NOT selected (The rest of the scrapped design) - Each person is responsible for their designs

Winner - To be decided on Saturday
-Final Concept (One of our design) - The person who's design wins
-Detailed Design

To be decided on Saturday
-Gantt chart progress evaluation
-Summary (Wtv)

$$S = \frac{k^*D}{T^*P}$$