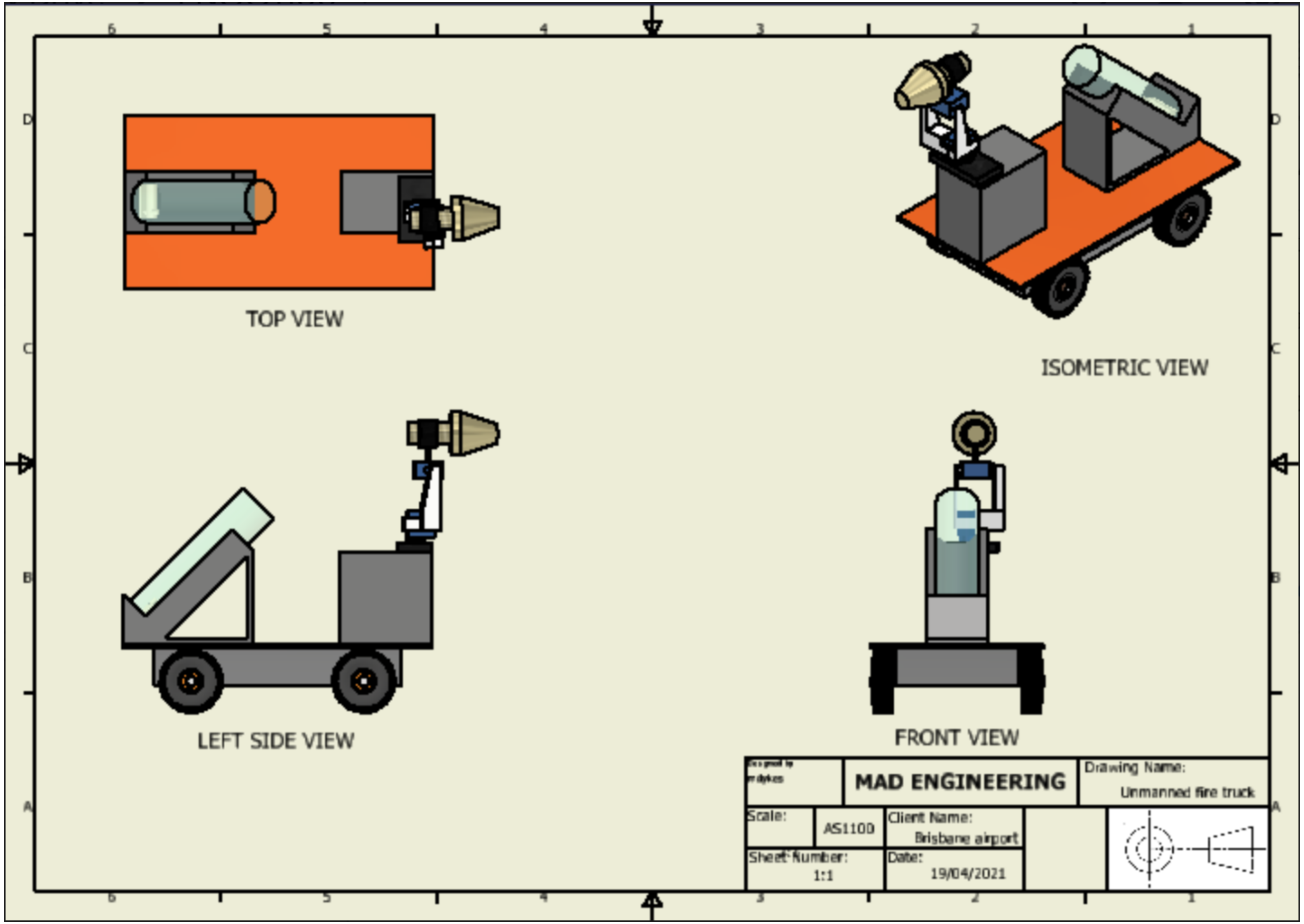
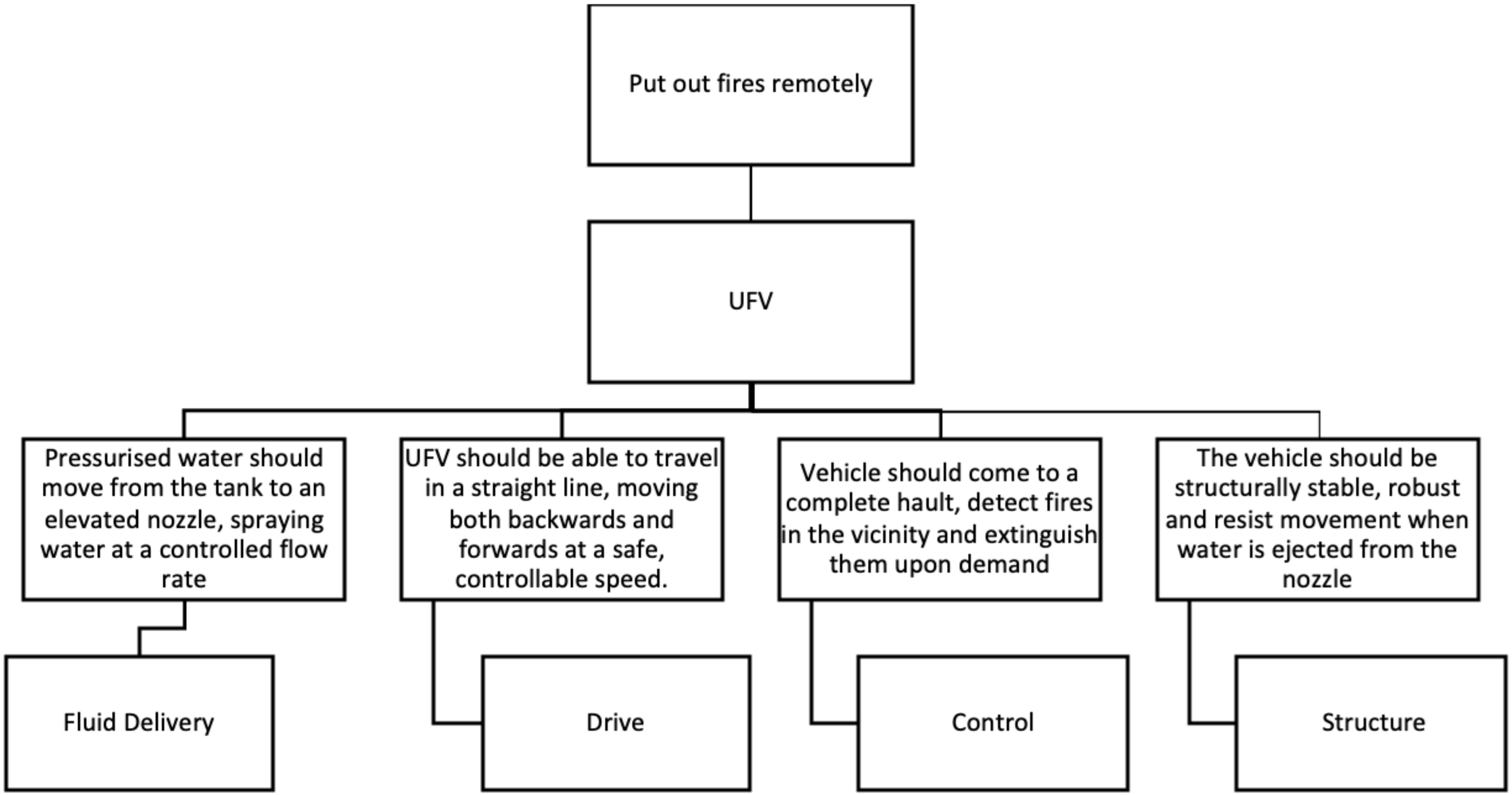
Milestone Presentation

PBL 12- Teal

Objectives	Constraints
To design an unmanned, lightweight, durable ground vehicle capable of effectively containing a fire.	The UGV’s length must be less than 300mm, width less than 200mm and height less than 300mm. The gross weight of the UGV, including water, must be under 3kg.
The UGV will be required to stop, start as well as travel in a forward and backward direction at a controllable speed.	Return to the starting point of the course.
The UGV will have a pump which will expel water alongside a rotating arm to direct the stream.	The drive, fluid and structural system must be located on the vehicle.
A reservoir stored on the UGV will contain water sufficient to extinguish multiple fires.	Power is supplied by batteries.
The structure itself must be firm, durable, withstand displacement while the fluid delivery system is in use at multiple trajectories.	Must extinguish fires within 6 minutes.


TOP VIEW
ISOMETRIC VIEW
LEFT SIDE VIEW
FRONT VIEW
MAD ENGINEERING
Drawing Name:
Unmanned fire truck
Scale:
AS1100
Client Name:
Brisbane airport
Sheet Number:
1:1
Date:
19/04/2021


Put out fires remotely
UFV
Pressurised water should move from the tank to an elevated nozzle, spraying water at a controlled flow rate
UFV should be able to travel in a straight line, moving both backwards and forwards at a safe, controllable speed.
Vehicle should come to a complete hault, detect fires in the vicinity and extinguish them upon demand
The vehicle should be structurally stable, robust and resist movement when water is ejected from the nozzle
Fluid Delivery
Drive
Control
Structure

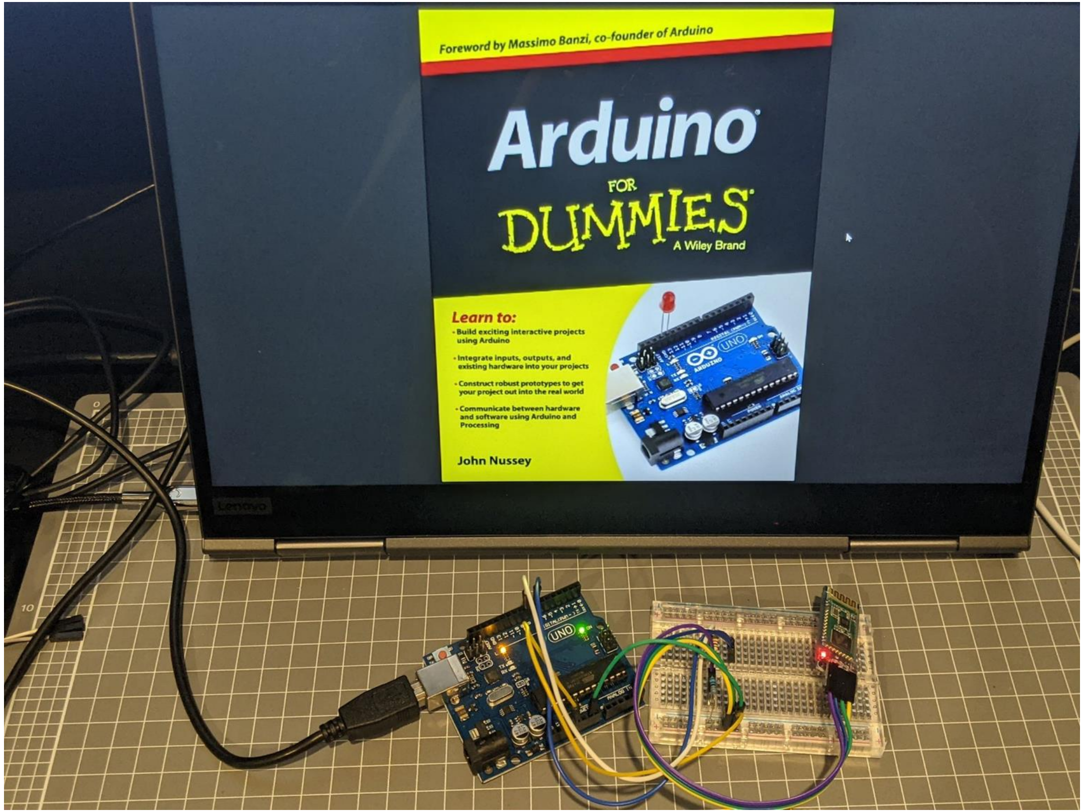
Control

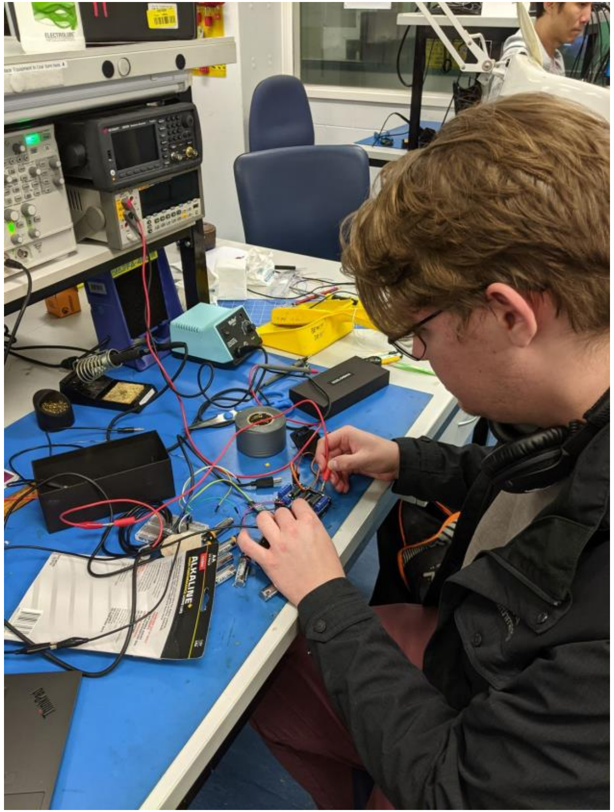
Control: Arduino with Bluetooth

- Using Arduino Uno with L293D Motor Driver Shield and HC-05 Bluetooth Module

- L293D shield can take up to 18V and distribute voltage evenly across all components.

Control Testing





Structure

Material of Chassis

Ideal chassis material for the UFV requires it to be:

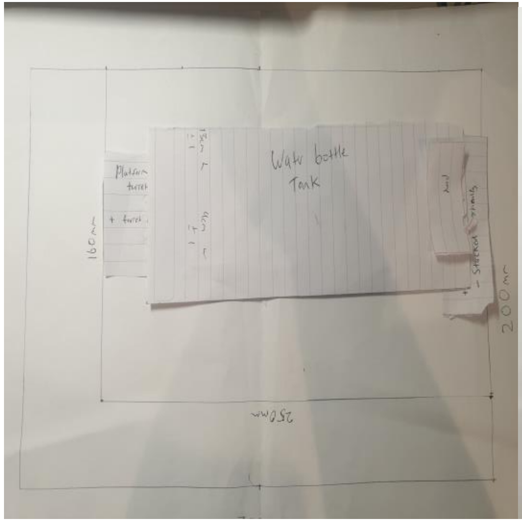
- Light
- Durable

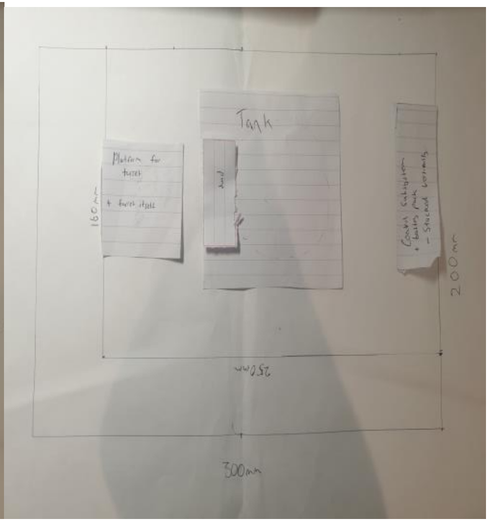
Other considerations:

- Heat resistant → resistant to potential flames

Therefore, aluminium was chosen to be the material for the chassis. This is because it is known for both its durability and its low weight compared to other metals.

Structure of Unmanned Firefighting Vehicle





Requirements

- to accommodate and protect all components → Chassis.
- Stable → Centre of gravity

Considerations

- Overall mass needs to be considered due to weight constraints.

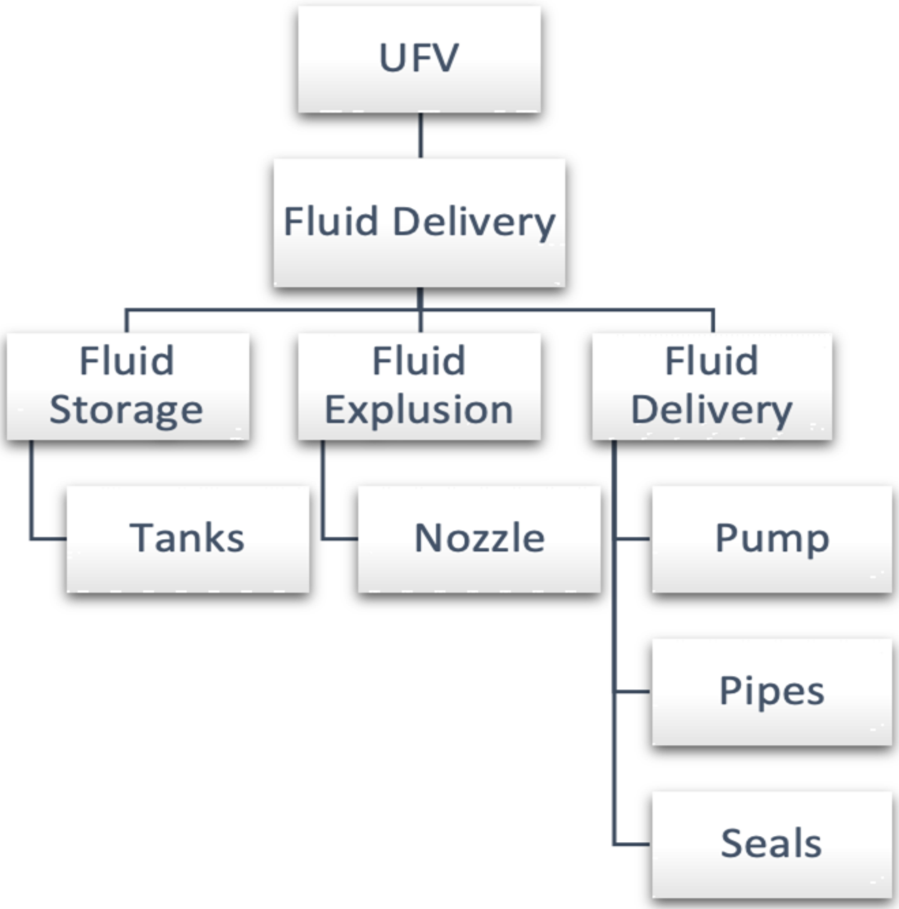
Structure of Unmanned Firefighting Vehicle

Chassis Design

Flat sheet chassis design was used because of the UFV's simple structural requirement.

A more complex design may not be needed, although it adds more structural support, it can increase the total mass of the UFV and its materials costs → not worth it.

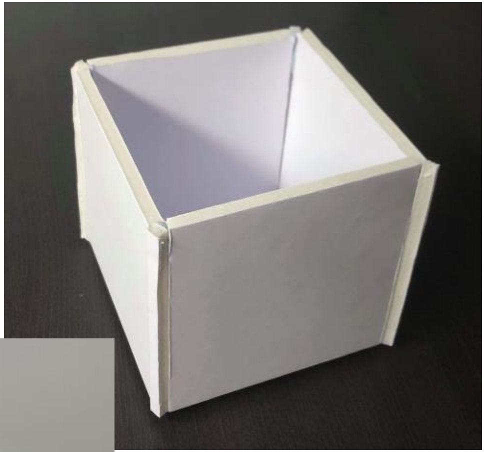
Fluid Delivery


UFV
Fluid Delivery
Fluid Storage
Fluid Explusion
Fluid Delivery
Tanks
Nozzle
Pump
Pipes
Seals

Fluid Storage

Two current options for the water tank:

- A 1L plastic bottle
  - More reliable
  - Durable
- Foam board tank
  - Sturdier, better weight distribution
  - Environmentally friendly



Fluid Delivery

Machifit JT80SL Submersible Water Pump

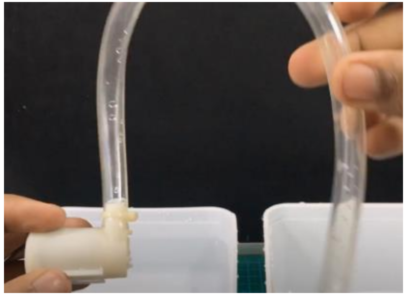
- DC 3-6V
- Max. 120L/H flow rate

Fluid Expulsion

1) Piping

Clear Vinyl Tubing 8mm x 5mm

Advantages: Lightweight and flexible



Fluid Expulsion

2) Nozzle

Extended Range Flat Fan

Hollow Cone Spray Nozzle

Spinning Tooth Nozzle

Fence Line Spray Nozzle

Fluid Expulsion

2) Nozzle

Extended Range Flat Fan

Hollow Cone Spray Nozzle

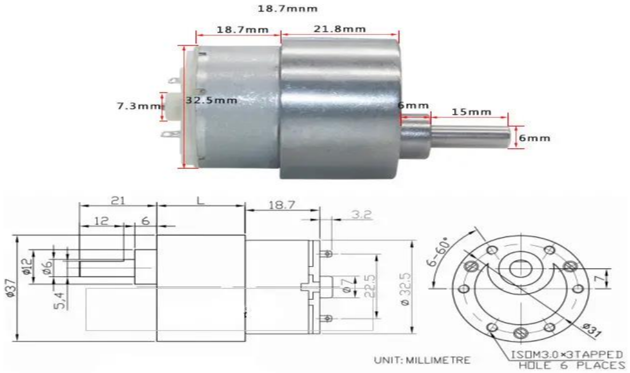
Spinning Tooth Nozzle

Fence Line Spray Nozzle

Drive

Drive

- 12V Machifit 33rpm DC Motor
- 3D printing gears with AutoCAD for customizability
- The gear was required to have strong tensility and efficie



hence the material used will be 3D printing plastic(ABS) instead of ready made gear selections using nylon.

Project Management

Failure Modes and Effects Analysis (FMEA)

The scope of analysis will allow us to define, identify, prioritise and then eliminate known or potential failures within the scope of the unmanned Firefighting vehicle. The UFV has many components within 4 larger subsystems. Due to the nature of the risk associated with each individual component the resolution of the FMEA is very specific, focusing on a component level. The focus must also be defined for our FMEA. Our focus is on a combination of different areas that hold equal weighting of importance to our project. Safety is of high importance, as is functionality. The aim of the project is to create a UFV that works according to the specified aim safely.

Hazard	Failure Mode	Causes	Consequences	Risk Priority Rating				Mitigation	Risk Priority Rating			
				Sev	*Prob*	*Det*	*RPN*		*Sev*	*Prob*	*Det*	*RPN*
Tanks	Tank not made securely so water leaks from openings	Poor manufacturing of the tank	Short circuits electrical boards if water gets into contact with it	4	2	1	8	Create tank out of non-permeable material so as to ensure no water leakage. Using centre of mass principles create a physically stable structure	4	1	1	4
	Tank not secured to chassis. Instability leads it to tipping over and falling	Poor choice of glue or other binding strategy										
	Tank tips over and pump is no longer submerged leading to the system operation failing	Instability of tank	Pump Stops									
Stability of Chassis	Material not strong enough to withhold the mass	Aluminium chassis too thin to be able to withstand the mass	Structure collapse	3	2	1	6	Increase thickness of chassis	3	1	1	3
Pipes	Piping unfastens itself from connecting components	Rapid movement of UFV causes piping to move	Water flow no longer continuous and hence it does not reach the nozzle. Cannot put of fires	2	3	2	12	Add extra material to secure piping	2	2	2	6
Battery	Wiring of battery	Not attached correctly	No current	2	1	2	4	Test with DC voltage to check if wired correctly	1	1	1	1
Material not able to withstand heat	Melting of metal	Materials sensitive to heat	System stops operating	4	2	2	16	Create a 'lid' like structure that goes over the main body of the UFV protecting the inner components from any external risks. Also adds aesthetic appeal	2	1	3	6
	Plastic melting	Piping too close to the heat source target										
	Electrical boards overheating	No proper insulation to protect systems from external heat sources and internal overheating										

Summary

Main area of concern where our system could most likely fail is due to the piping.

Mitigation techniques must be put into place to ensure the UFV functions accordingly

Completion Plan

Gantt chart

Fireman Sam (Unmanned Firefighting Vehicle)

Team Teal

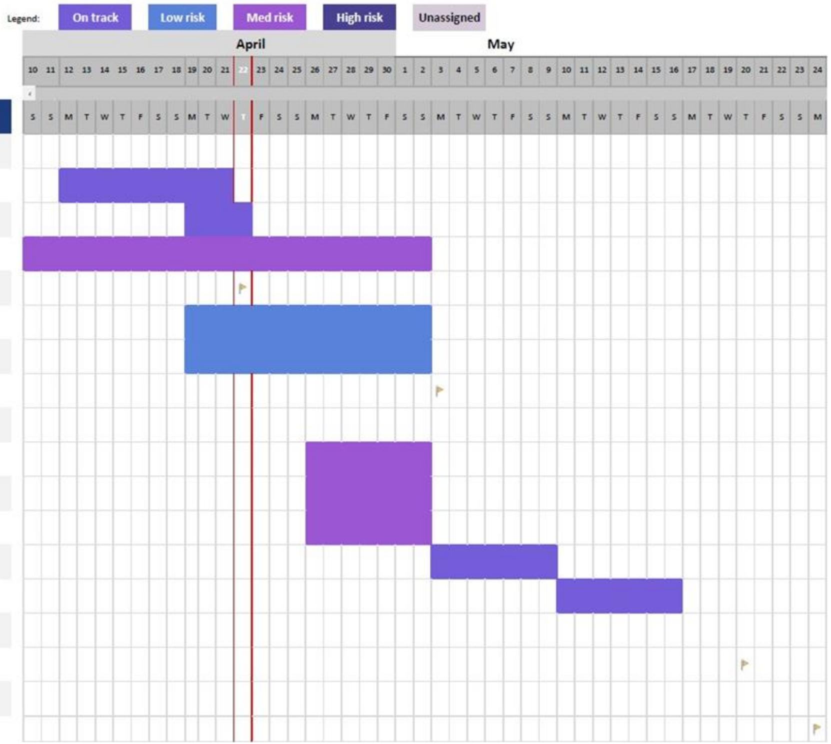
Team Lead: Hana Abdelhameed

Team Members: Hana Adbelhameed, Ethan Chai, Charlotte Watts, Mitchelle Dykes, Riley White, Jay Hunter

Project Start Date: 15/02/2021

Scrolling Increment: 7

Milestone description	Category	Assigned to	Progress	Start	Days
Construction					
Bild Chassy	On Track	Hana & Ethan	100%	12/04/2021	10
Build Tank with Pump	On Track	Hana & Charlotte	100%	19/04/2021	4
Build Control & Power System	Med Risk	Jay	70%	5/04/2021	28
Design Presentation	Milestone	Hana, Ethan, Charlotte, Mitchelle, Riley, Jay		22/04/2021	1
Build Drive System	Low Risk	Riley	25%	19/04/2021	14
Build Turret	Low Risk	Mitchell	25%	19/04/2021	14
Complete Construction	Milestone	Hana, Ethan, Charlotte, Mitchelle, Riley, Jay		3/05/2021	1
Testing					
Test Controlling Each Component Seperatly	Med Risk	Jay	0%	26/04/2021	7
Test Controlling Multiple Components	Med Risk	Jay	0%	26/04/2021	7
Test for Edge Cases	Med Risk	Jay	0%	26/04/2021	7
Trial Run in Arena 1	On Track	Hana, Ethan, Charlotte, Mitchelle, Riley, Jay	0%	3/05/2021	7
Trial Run in Arena 2	On Track	Hana, Ethan, Charlotte, Mitchelle, Riley, Jay	0%	10/05/2021	7
Show Time					
Take out the fires and the judges hearts at the demo	Milestone	Hana, Ethan, Charlotte, Mitchelle, Riley, Jay	0%	20/05/2021	1
Final Report					
Complete and Hand-in Final Report	Milestone	Hana, Ethan, Charlotte, Mitchelle, Riley, Jay	0%	24/05/2021	1



Appendix (1): Defined Weightings

	Weightings		Definition
Severity	4	Catastrophic	Extremely severe consequences to both the system and individuals around it. (95% - 100% system failure)
	3	Critical	System is no longer functioning accordingly to the aim (efficiency of output is reduced by 40%)
	2	Marginal	Risk of severity is not that high. (efficiency of output is reduced by 20%)
	1	Negligible	No threat detected (minimum 5% impact of total output and functionality)
Probability	4	Expected	Will most likely occur immediately
	3	Occasional	75% chance of occurrence
	2	Remote	>50% chance of occurrence
	1	Improbable	>10% chance of occurrence
Detection	4	Impossible	Impossible to detect
	3	Possible	<50% chance of detection
	2	Likely	<75% chance of detection
	1	Certain	100% chance of detection

Q&A