Project Deliverable C

GNG 1103

Team D6

“Diamond Hands”

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Introduction

The main focus of this document is to explore and benchmark designs that already exist and are in use currently. By analysing designs, we are able to get an understanding of what technology already exists on the market, what technology can be improved, and what users will expect out of our solutions. The three designs we benchmarked are the Google Project Wing, Drone Delivery Canada (Sparrow), and Amazon Prime Air. Each of these companies are currently in service and are operating. Looking at the similarities and differences in each of the companies and how they relate to the safety of the package and its contents is the primary focus of our benchmarking.

Benchmarking

Table 1. Benchmarking Findings

Specs\Drone	**Google's Project Wing (Series 7000)**	**Drone Delivery Canada (Sparrow)**	**Amazon Prime Air (MK27)**
Method of delivery	Retractable tether system. (Does not land)	Retractable tether system	Landing
Axis of movement	6 axis	4 axis	6 axis
Target Market	Food, Pharmaceuticals, Groceries, Hardware	Industry transport, courier services.	Food, Pharmaceuticals, Groceries
Payload	1.5kg	4.5 kg	2.27kg
Range	20km	30 km	24km
Speed	113kph	80kph	80.5 kph
Power Source	12 lift propellers (hover)(vertical) 2 wing mounted propellers (flight)(horizontal)	8 Electric Motors	6 Motors
Navigation	wifi/GPS	GPS Based	Wifi/GPS
Safety to general Public	UAS Traffic Management system Opensky software Radar, lidar, cameras	FLYTE software monitors air traffic, weather, obstacles, and other elements	Visual, thermal, and sonar sensors Integrated AI responds to adverse conditions

Table 2. Ranking of Findings

Specs\Drone	**Importance**	**Google's Project Wing (Series 7000)**	**Drone Delivery Canada (Sparrow)**	**Amazon prime Air (MK27)**
Method of delivery	2	3	2	1
Axis of movement	3	3	2	3
Target Market	1	3	2	3
Payload	2	1	3	2
Range	3	1	3	2
Speed	2	3	1	2
Power Source	3	3	2	1
Navigation	4	3	2	3
Safety to general Public	5	2	1	3
Total		60	48	58

Summarising Findings

Google Wing (Series 7000) is the most comparable drone delivery service to that proposed by JAMZ. The main similarity is the retractable tether system which eliminates the need to land during the delivery process. An inherent benefit because of this is an added layer of protection from drone theft. For example, Google's Wing has the safeguard in place where in the event a customer pulls from the tether, the tether would release from the drone and return to site. Secondly, eliminating the need to land reduces the overall power consumption of the delivery process as the most energy intensive aspect is lifting off the ground. However, Google Wing focuses on smaller payloads (1.5kg) which limits the total addressable market. Google Wing is the fastest drone which could be due to compromises with payload size to decrease delivery time. Another consequence of prioritizing quick delivery times is the 20km range, the smallest of all the comparable drones. Lastly, Google Wing integrates safety for itself and the environment through its unmanned traffic management (UTM) tools and flight planning software that creates routes to avoid obstacles and indicate that it's safe to fly to the customer's delivery location.

Amazon Prime Air (MK27) is very comparable to Google Wing; however, the Amazon drone lands to complete the delivery process. Amazon Prime Air carries a heavier payload (2.27kg) than Google Wing. As a result, the speed at which Amazon Prime Air's operating speed (80.5km/h) is much slower than that of Google's Wing (113km/h). Amazon also has a longer range (24km) than Google (20km). This is due to the fact that Google's Wing prioritizes speed which requires overall less weight carried by the drone. Both Google Wing and Amazon Prime Air use the same navigation systems, and similar to Google Wing, Amazon also adds in their form of artificial intelligence into their drones for flight management and environmental concerns. This is beneficial for the safety of the public as well because the onboard computer is smarter. Due to the fact that the respective compromises of both Google and Amazon only marginally impact the outcome of the delivery process, their total scores represented in table 2 reflect their overall similarity.

Drone Delivery Canada is uniquely positioned in the industrial transportation industry and because of this, the Drone Delivery Canada drone's design is mainly targeted towards different priorities. For example, the Drone Delivery Canada sparrow drone can carry the heaviest payload (4.5 kg) and travel the longest range also (30 km). However, the direct compromise of being able to carry the heaviest payload is a decrease in speed (80 km/h), rendering the sparrow drone the slowest of the technical benchmarks. The retractable tether feature which the sparrow drone is equipped with, allows for the drone to complete the delivery process without the need to land or come into contact with another person. However, the compromises for Drone Delivery Canada are regarding overall quality. For example, the onboard computer FLYTE software is reliant on operators in a traffic control room compared to the completely autonomous drone service from amazon using integrated artificial intelligence to react or Google Wing's UTM. Another example is that Drone Delivery Canada uses only GPS to record and transmit the navigation data whereas both Amazon and Google are able to navigate via wifi and GPS. The reason for the navigation systems compromise is related to the rural market which Drone Delivery Canada is targeting, therefore the lack of cellular infrastructure in rural areas would limit the practicality of the wifi navigation. Whereas, the urban market is much more industrialized which increases the usefulness of the added layer of navigation.

Functional Requirements

Table 3. Functional Requirements

	Design Specifications	**Relation (=,< or >)**	**Value**	**Units**	**Verification Method**
1	Method of Delivery - Tether	=	yes	N/A	Test
2	Navigation systems	=	yes	N/A	Test
3	Axis of Movement	>	4	°	Test
4	Ability to collect and send data	=	yes	N/A	Test

Constraints

Table 4. Constraints

	Design Specifications	**Relation (=,< or >)**	**Value**	**Units**	**Verification Method**
1	Payload Capacity	<	15	kg	Test
2	Cost	<	50	$	Estimate, final check
3	Operating Temperature	<	40	°C	Test
4	Range	<	20	km	Test

Non-Functional Requirements

Table 5. Non-Functional Requirements

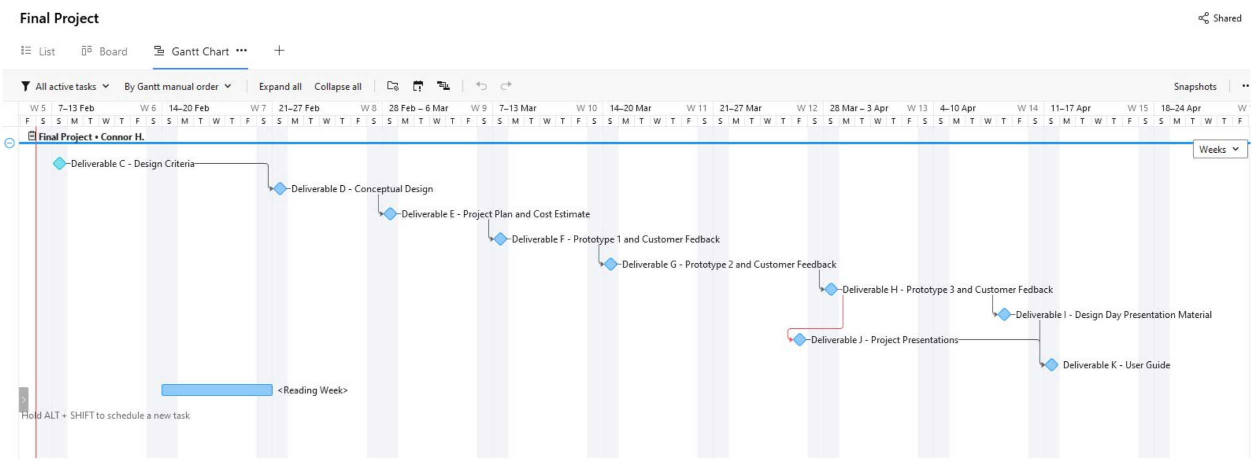
	Design Specifications	**Relation (=,< or >)**	**Value**	**Units**	**Verification Method**
1	Aesthetics	=	yes	N/A	Test
2	Safety: Minimal Pinch, Prick Points	=	yes	N/A	Test
3	Reliability	=	yes	N/A	Test

Conclusion

While all three companies observed are all good candidates for benchmarking, overall Google's Project Wing Series 7000 proved to be the best according to our matrix. The Project Wing Series 7000 does not have the same payload capacity or range as the Canada Drone Delivery Sparrow and lacks a few of the safety features present in the Amazon Prime Air drone. We should look to incorporate and keep in mind these areas that are weaker in the Project Wing Series 7000 when developing systems for the JAMZ drone.

While the speed is a good element of the Google Project Wing Series 7000, the reduced range and capacity of the drone is something we don't want to compromise, losing range at the cost of delivering packages in a slightly shorter amount of time does not look to be a worthwhile tradeoff. The speed of drone delivery is already much lower compared to other means of delivery, prioritising the range of application will be a priority in the future, this means lowering power consumption and keeping the weight down.

While a Wifi and GPS based navigation systems seems to be the best, in rural applications Wifi signals become far and few between. We should look to use GPS based navigation systems as they will be most applicable to the context of the JAMZ drone, it eventually will operate under similar circumstances to the Canada Drone Delivery Sparrow, we should keep this in mind going forward.


Final Project
Shared
List
Board
Gantt Chart
All active tasks
By Gantt manual order
Expand all
Collapse all
Snapshots
W 5
7–13 Feb
W 6
14–20 Feb
W 7
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W 8
28 Feb – 6 Mar
W 9
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W 10
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Weeks
Final Project • Connor H.
Deliverable C - Design Criteria
Deliverable D - Conceptual Design
Deliverable E - Project Plan and Cost Estimate
Deliverable F - Prototype 1 and Customer Fedback
Deliverable G - Prototype 2 and Customer Feedback
Deliverable H - Prototype 3 and Customer Fedback
Deliverable I - Design Day Presentation Material
Deliverable J - Project Presentations
Deliverable K - User Guide
<Reading Week>
Hold ALT + SHIFT to schedule a new task