NEMO

Spring 2024 Final Presentation

OUR TEAM

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AGENDA

01
PROJECT OVERVIEW
A high-level description of our project.

02
ORIGINAL PROJECT
Project as it was given to our team.

03
FRONTEND
An overview of the frontend changes.

04
BACKEND
An overview of the backend developments.

05
TIMELINE
Planned tasks for future teams.

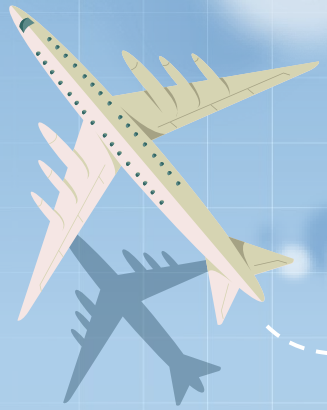
06
LESSONS LEARNED
Lessons learned throughout the project.

PROJECT OVERVIEW

Updating an existing Web application that allows users to select airplanes or airports and listen to Air Traffic Communication (ATC) audio. Integrates NVIDIA NeMo Automatic Speech Recognition (ASR) to transcribe ATC. Creation of a Communications database.

SINCE THE BEGINNING

- Heavy Frontend Development
- Successful integration of database & web application
- Successful integration of NeMo to allow for live transcription and audio storage



BUDGET

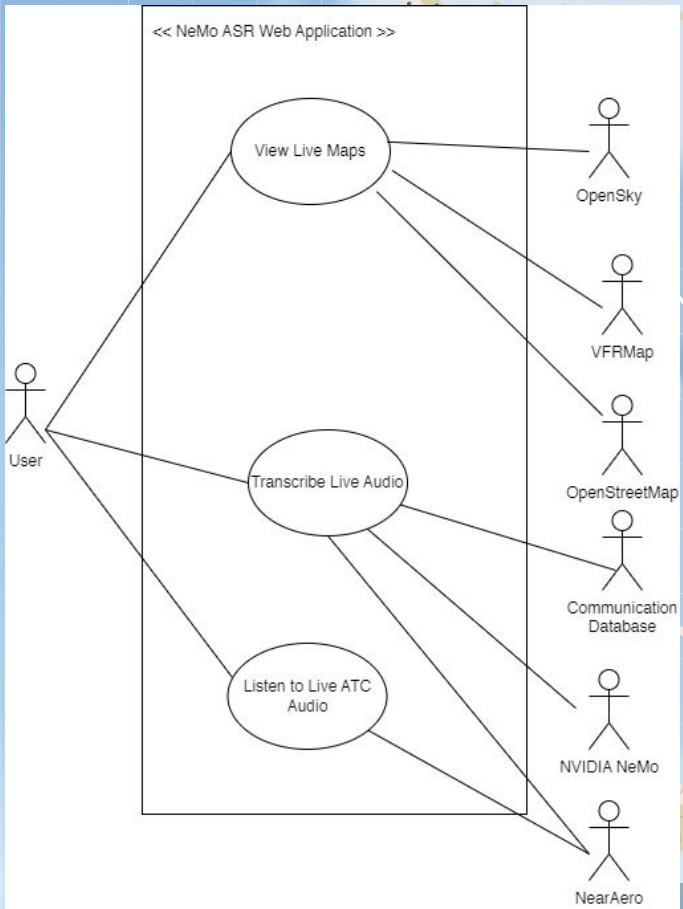
We currently use only open-source software.

Future Budget:

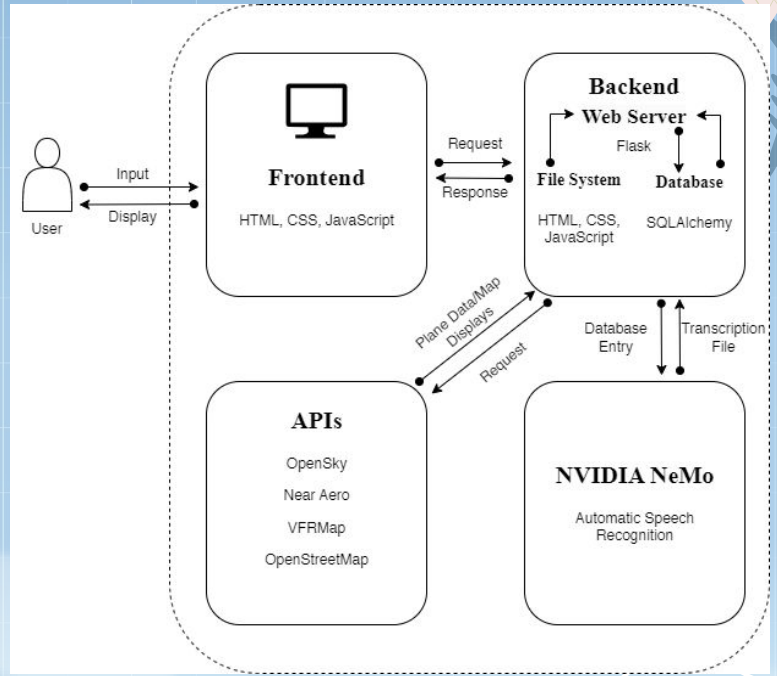
Due to API difficulties, there is a possibility that commercial software will be acquired in the future. If this becomes the case, we will have to consult Dr. Liu on an official budget.

- One possible fix involves using the College of Aviation ADS-B, which should not involve a significant cost.

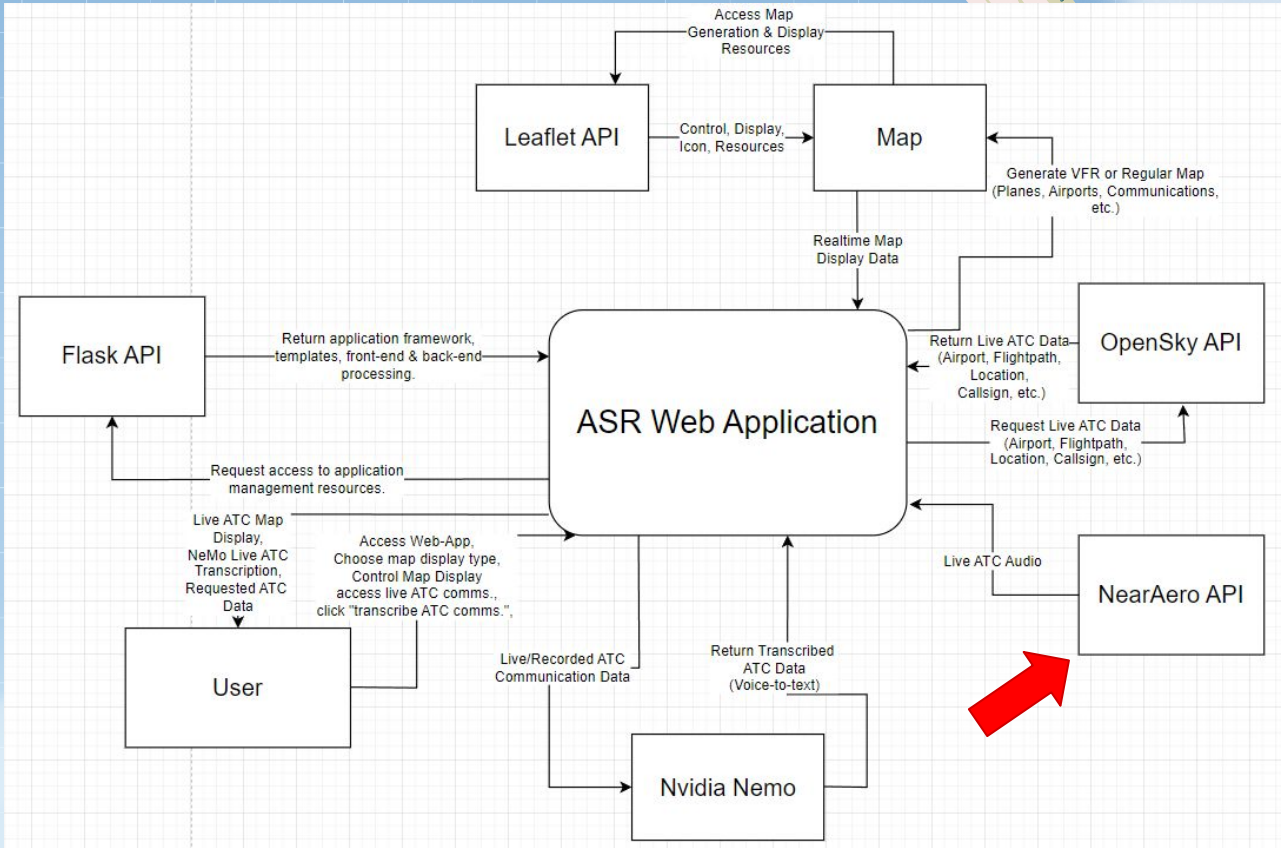
SYSTEM OVERVIEW



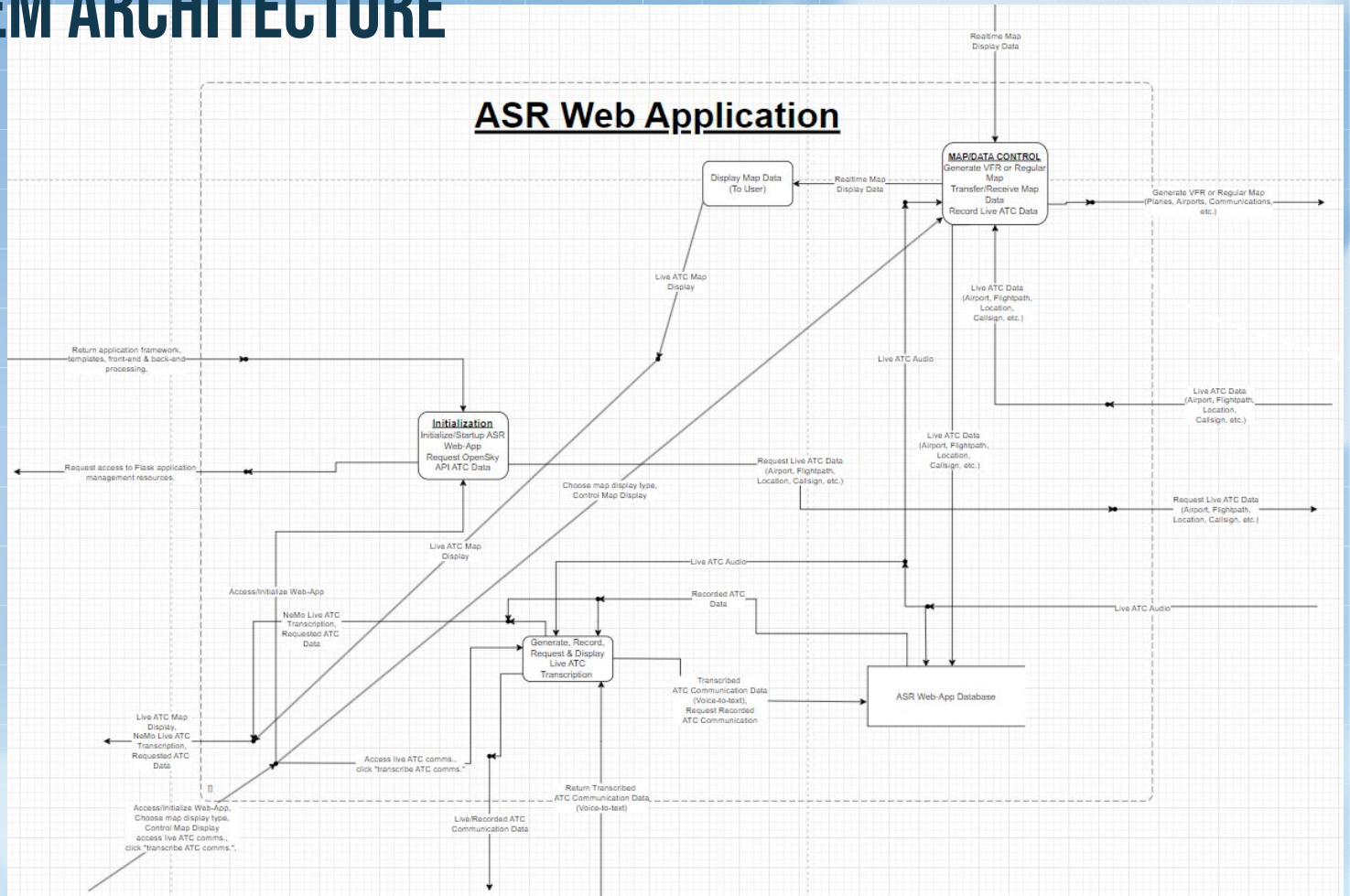
SYSTEM ARCHITECTURE



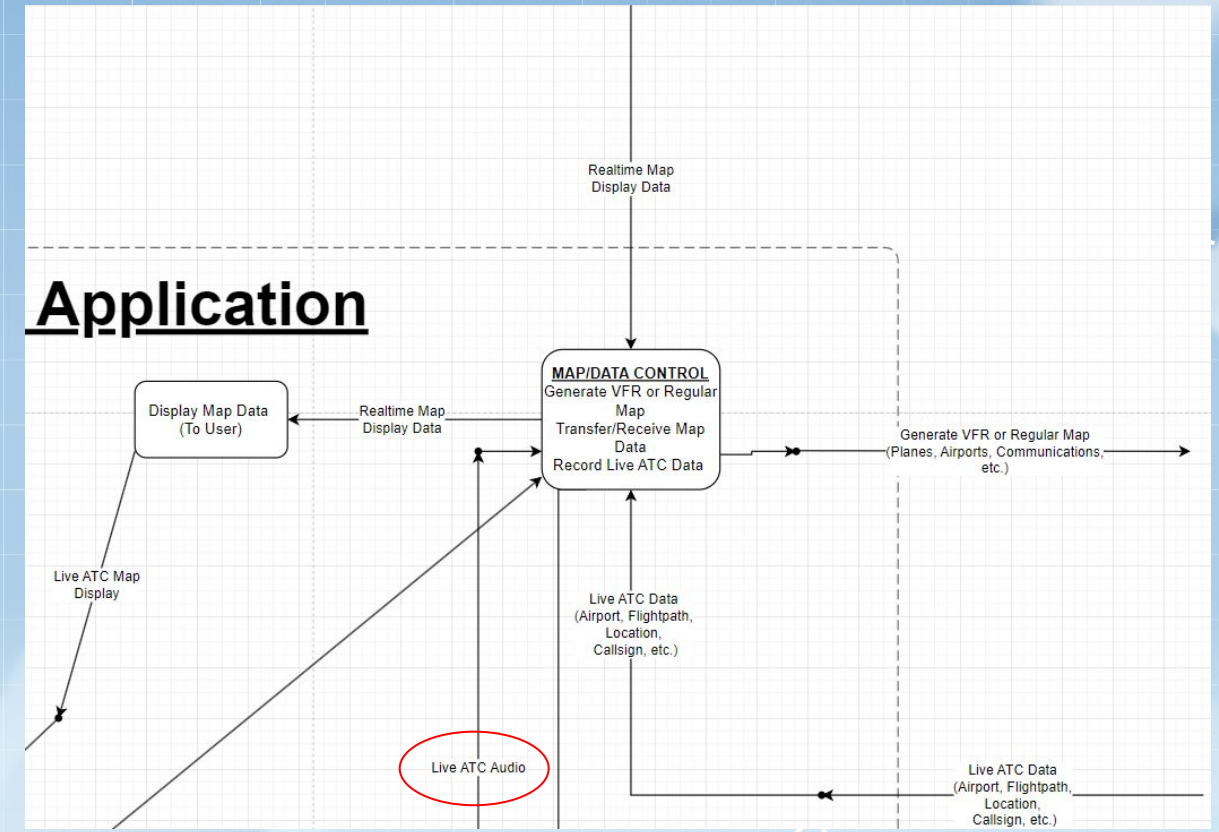
SYSTEM ARCHITECTURE



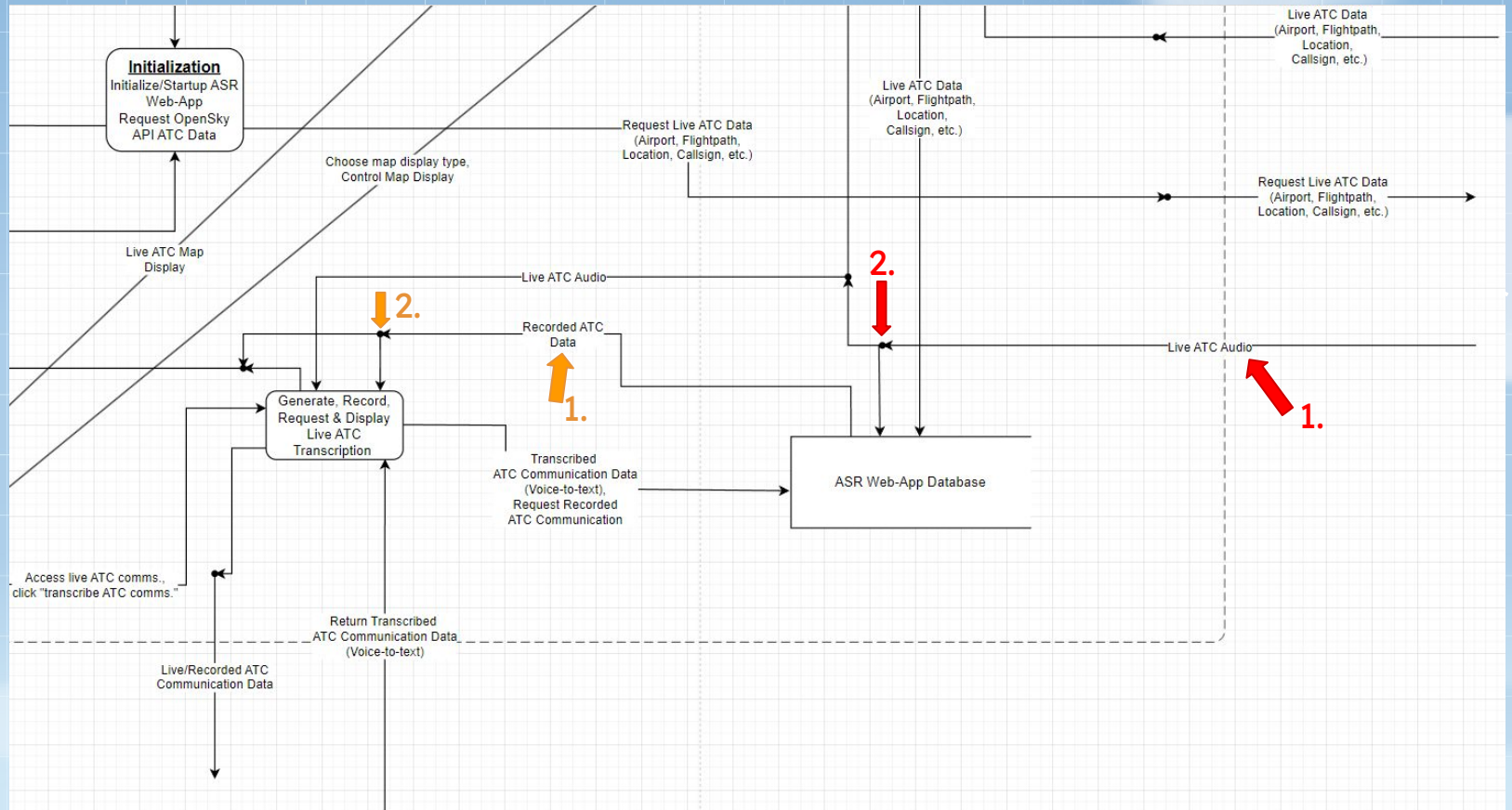
SYSTEM ARCHITECTURE

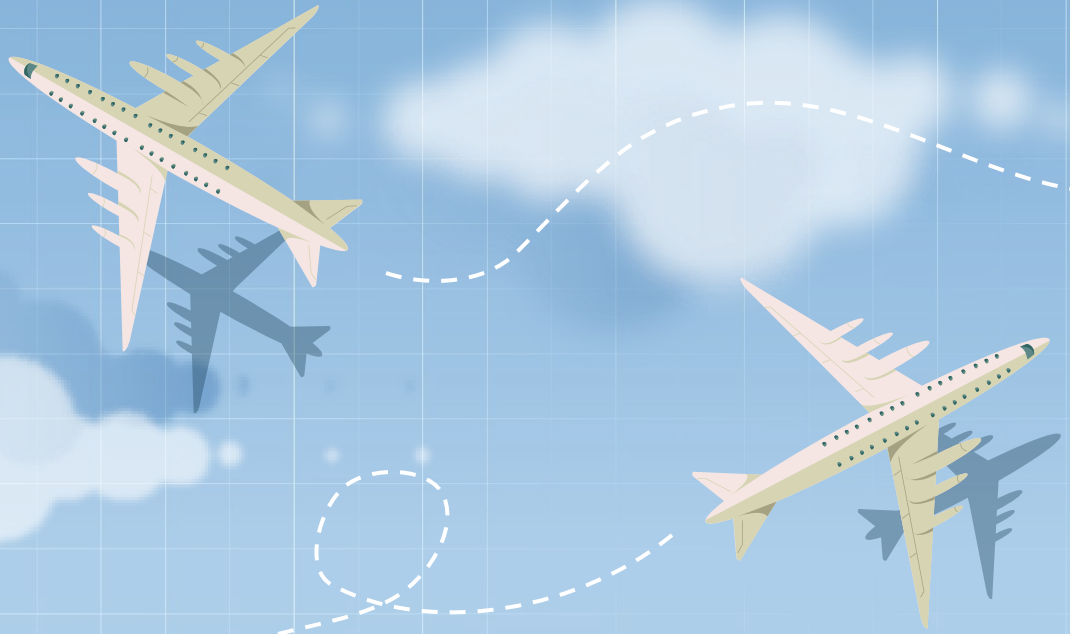


SYSTEM ARCHITECTURE



SYSTEM ARCHITECTURE





02

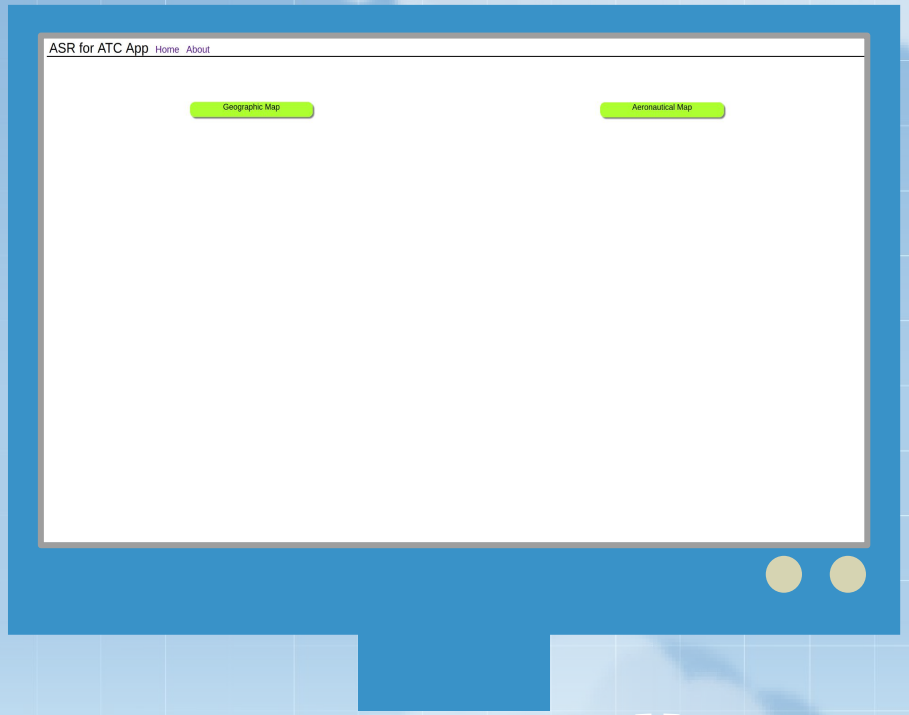
ORIGINAL

As Our Team Received The Application

ORIGINAL HOMEPAGE

Basic homepage with only three buttons, two of which lead to empty pages.

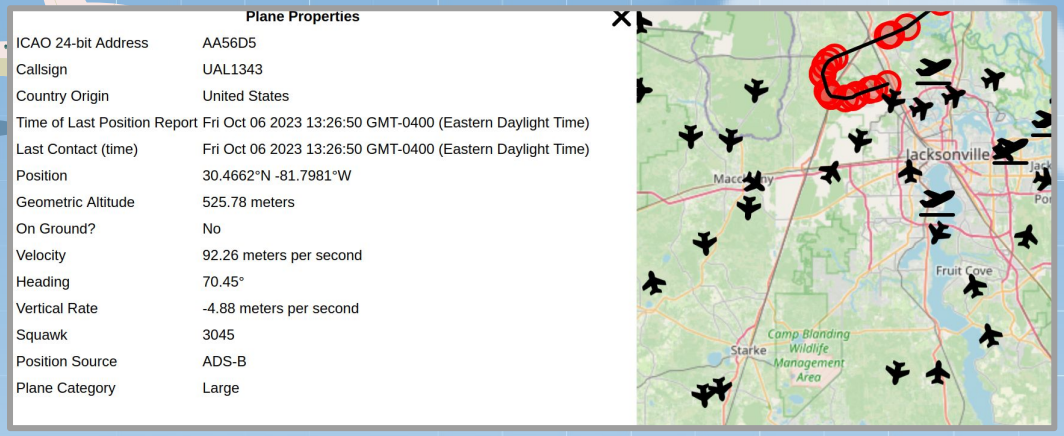
Different map modes originally planned for different pages

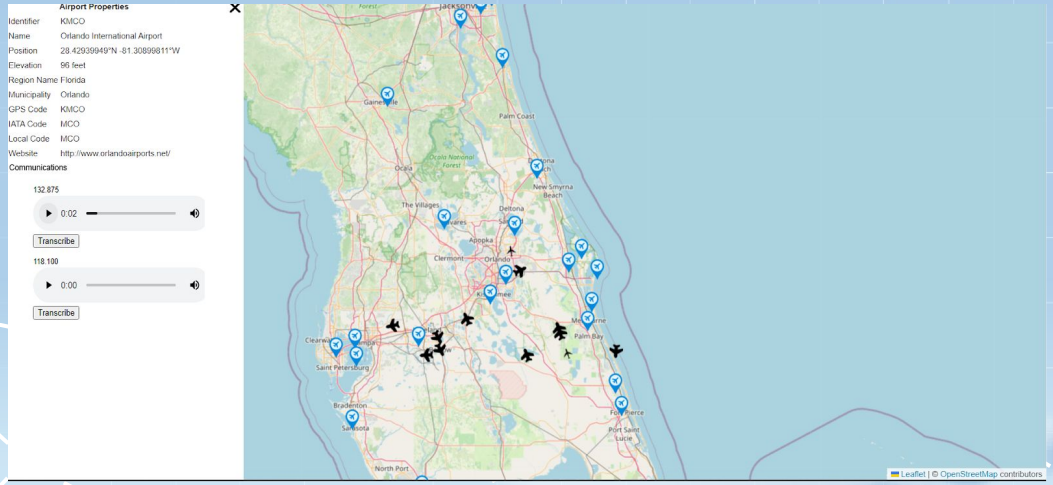


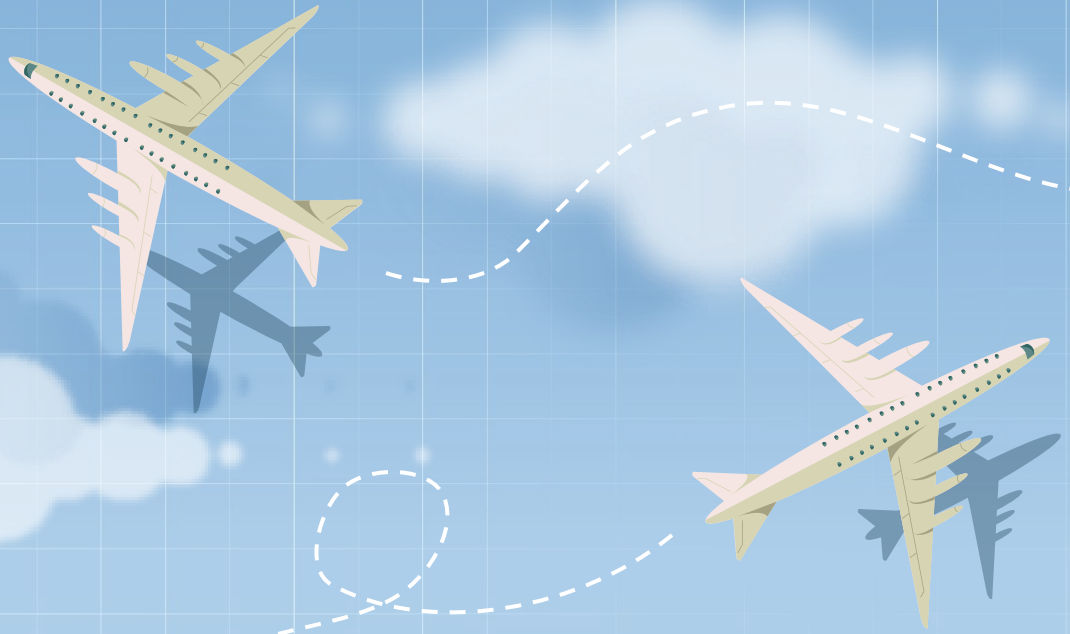
ORIGINAL MAP SCREEN

Top image shows zoomed in view of map screen with original plain black plane and airport icons

Bottom image shows zoomed out view of map screen with new airport icons but original crowded properties pane







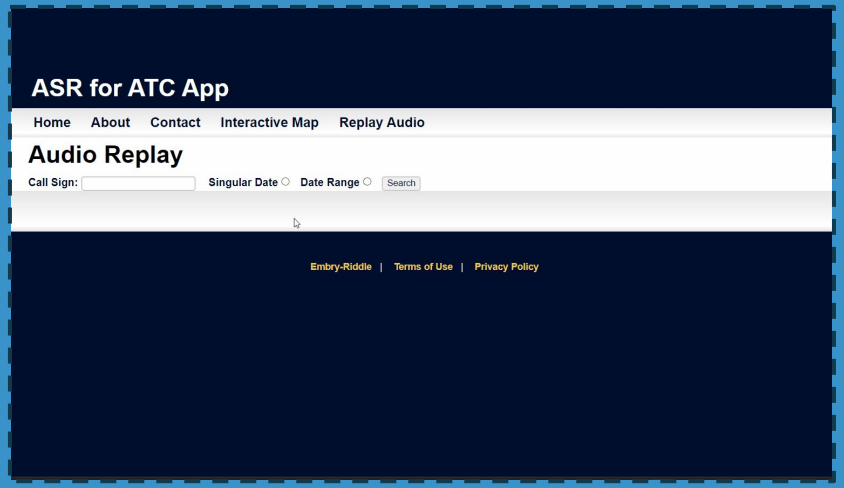
03

FRONTEND

User interface updates

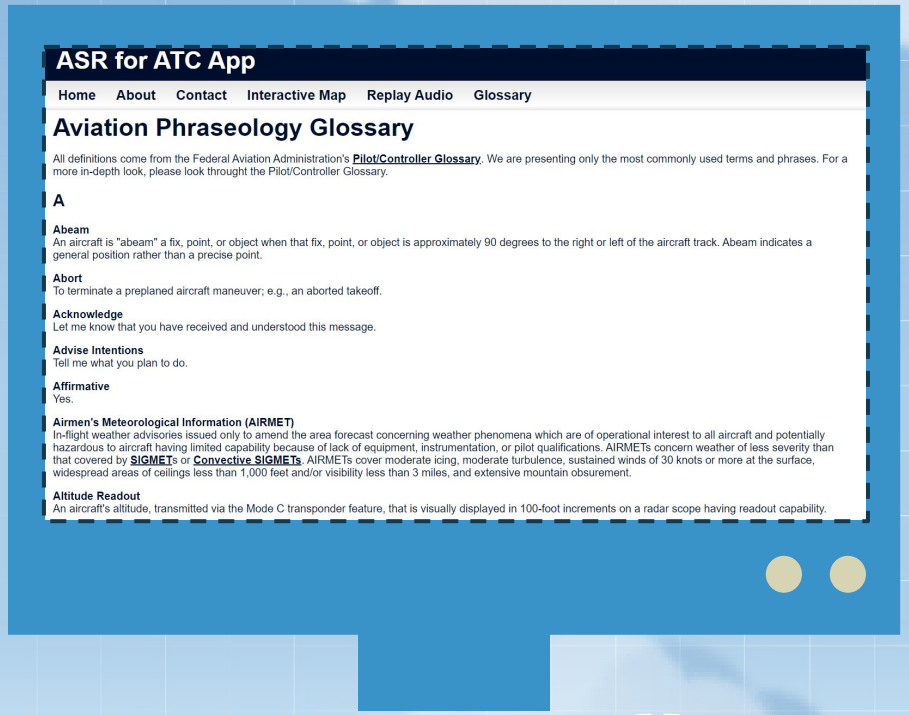
AUDIO REPLAY PAGE

Added a search bar and different input options based on the type of date the user wants to search for to the audio replay screen for database querying of historic data.



PHRASEOLOGY GLOSSARY

Added a glossary for ATC Phraseology with the most used terms/phrases with a link to a more in-depth glossary as well.



ASR for ATC App

Home About Contact Interactive Map Replay Audio Glossary

Aviation Phraseology Glossary

All definitions come from the Federal Aviation Administration's **Pilot/Controller Glossary**. We are presenting only the most commonly used terms and phrases. For a more in-depth look, please look throught the Pilot/Controller Glossary.

A

Abeam
An aircraft is "abeam" a fix, point, or object when that fix, point, or object is approximately 90 degrees to the right or left of the aircraft track. Abeam indicates a general position rather than a precise point.

Abort
To terminate a preplaned aircraft maneuver; e.g., an aborted takeoff.

Acknowledge
Let me know that you have received and understood this message.

Advise Intentions
Tell me what you plan to do.

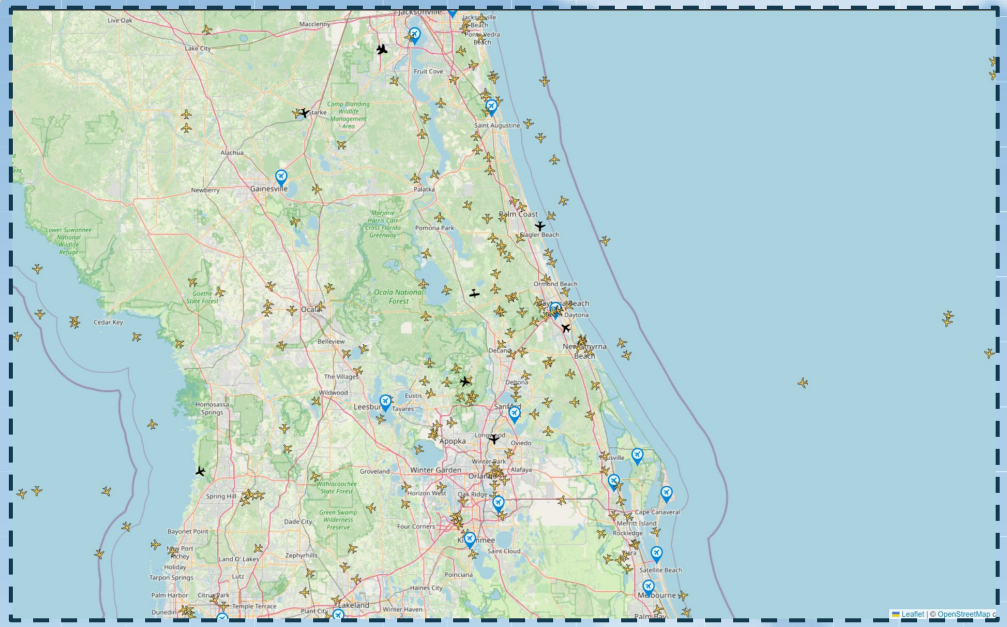
Affirmative
Yes.

Airmen's Meteorological Information (AIRMET)
In-flight weather advisories issued only to amend the area forecast concerning weather phenomena which are of operational interest to all aircraft and potentially hazardous to aircraft having limited capability because of lack of equipment, instrumentation, or pilot qualifications. AIRMETs concern weather of less severity than that covered by **SIGMET**s or **Convective SIGMETs**. AIRMETs cover moderate icing, moderate turbulence, sustained winds of 30 knots or more at the surface, widespread areas of ceilings less than 1,000 feet and/or visibility less than 3 miles, and extensive mountain obsurement.

Altitude Readout
An aircraft's altitude, transmitted via the Mode C transponder feature, that is visually displayed in 100-foot increments on a radar scope having readout capability.

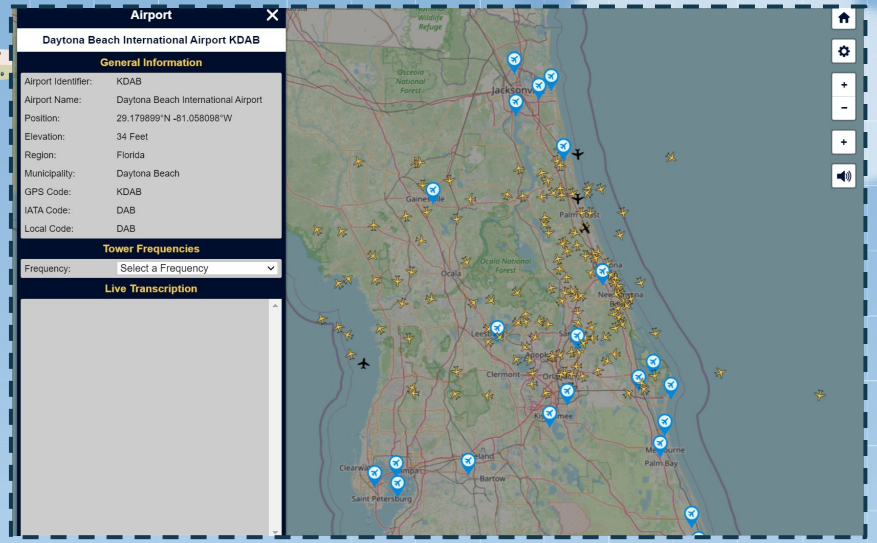
IMPROVED PLANE ICONS

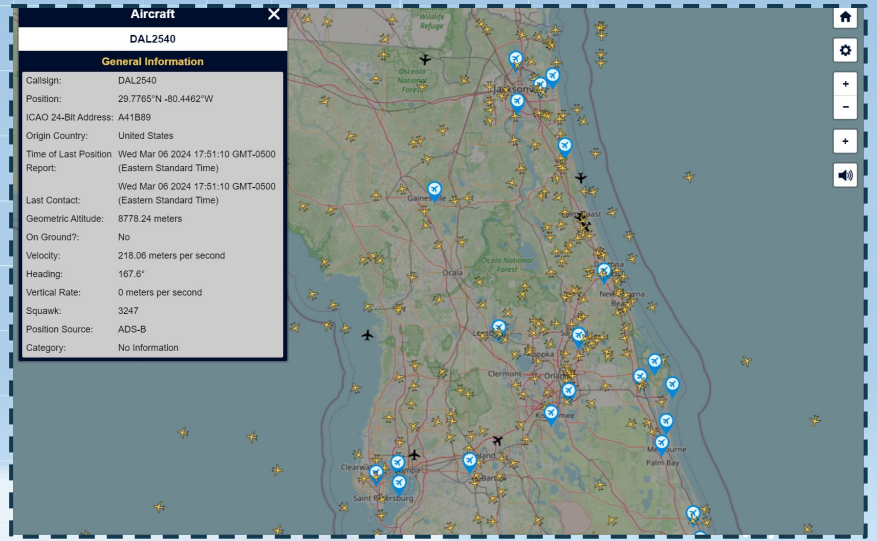
Facelift of key web application, improved plane icons now with color. Yellow by default, different colors for hover over, selection, and active speaker



STYLIZED PANELS

Facelift of key web application features to ensure visibility and ease of access for future users

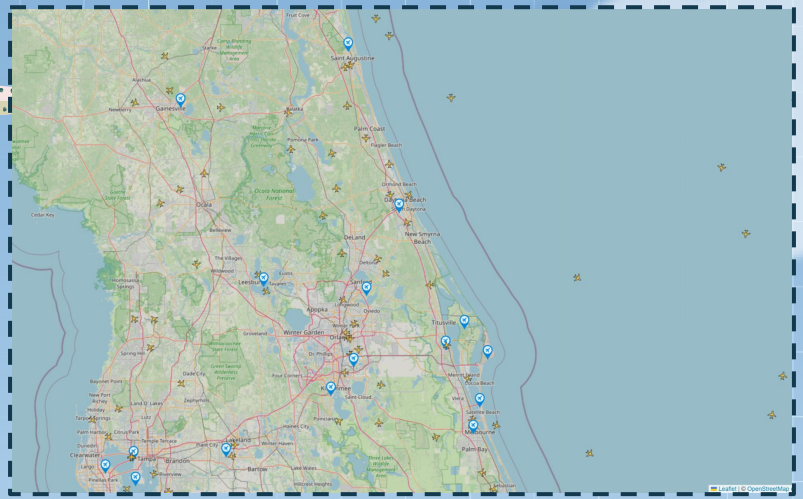


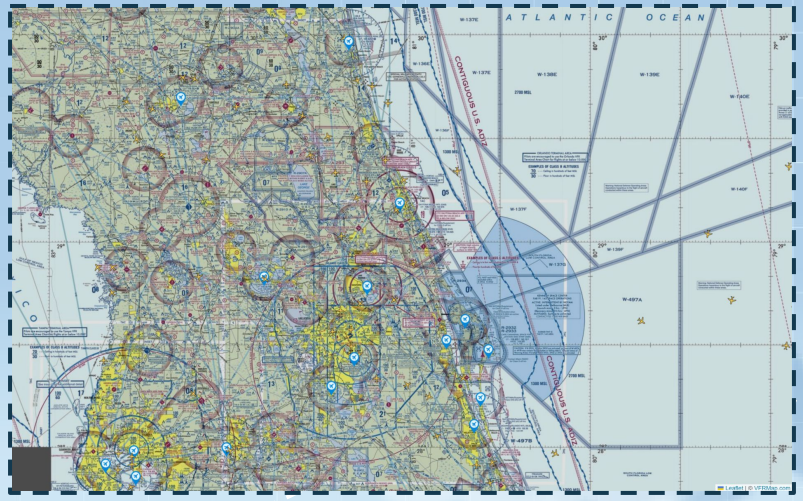


(Top) Airport Information with Tower Frequencies available, (Left) Aircraft Information

MAP MODES

Five additional Map modes were added to the web application along side the basic geographic map.





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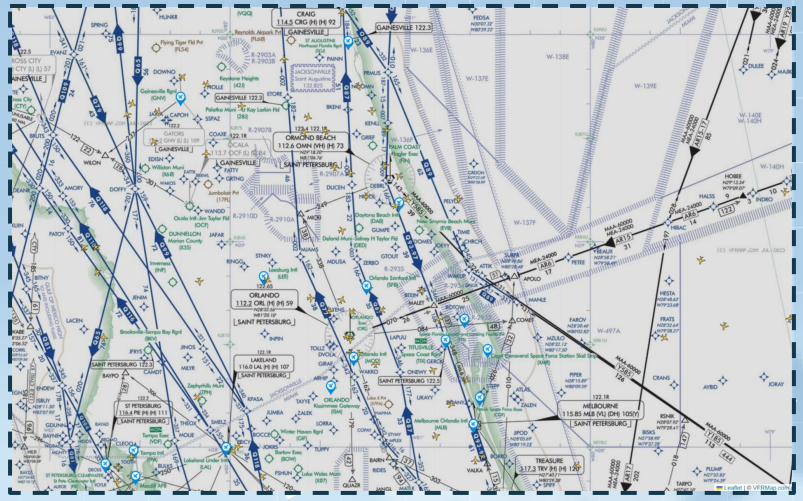
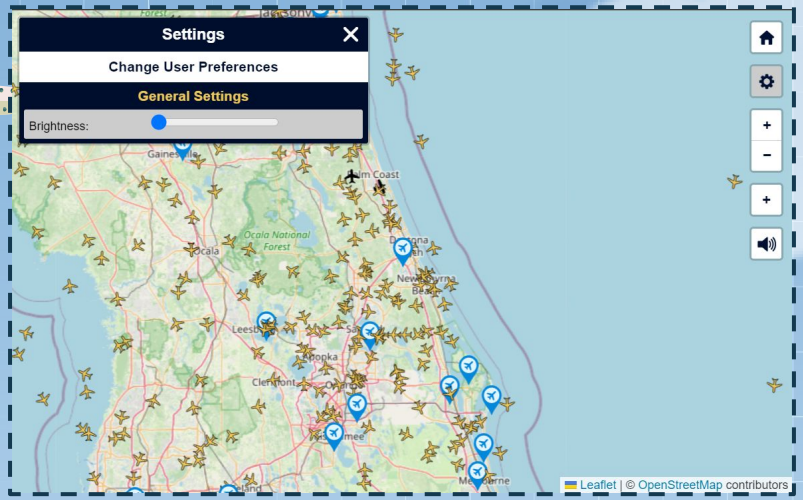
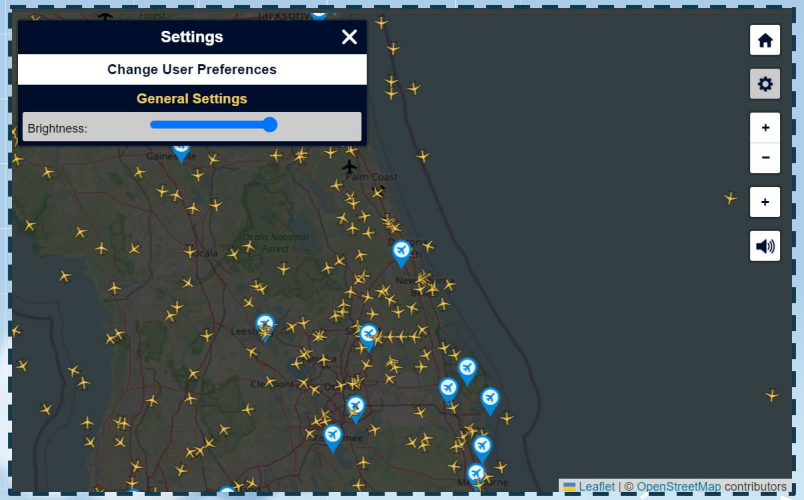
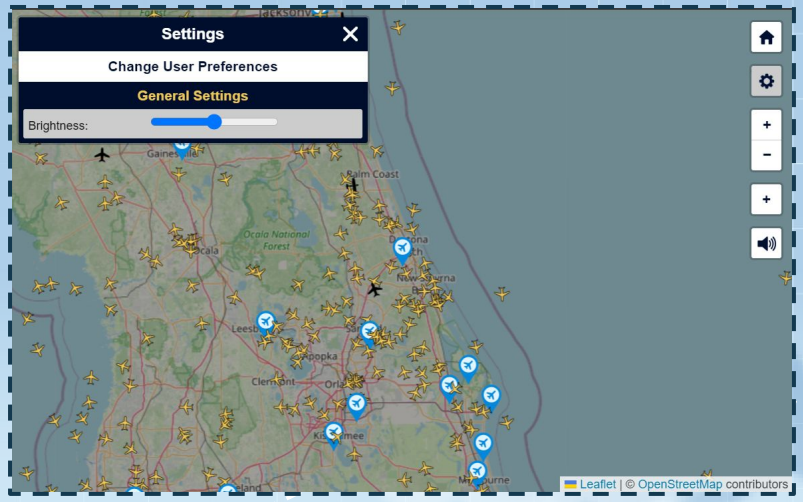


BRIGHTNESS

For various ease of use in various environments a brightness setting was introduced.

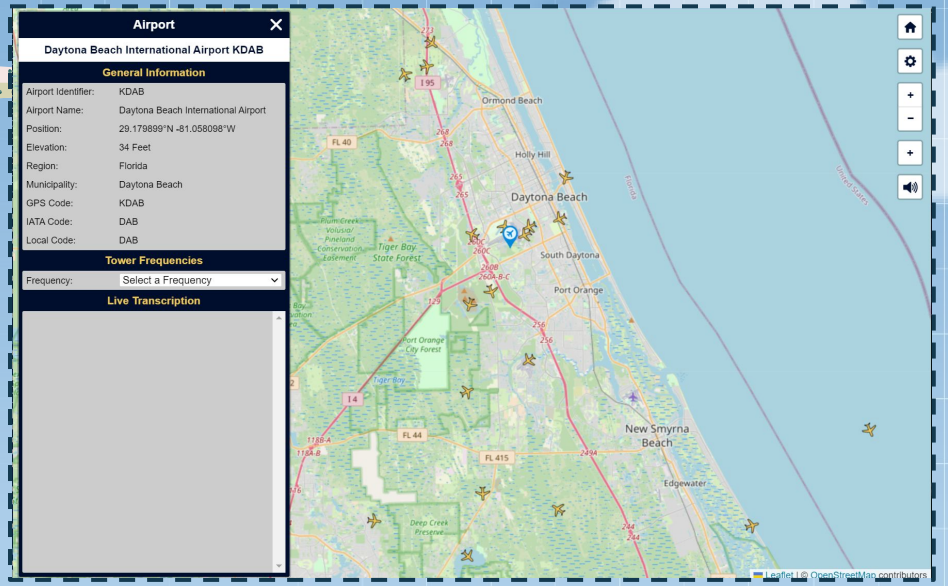


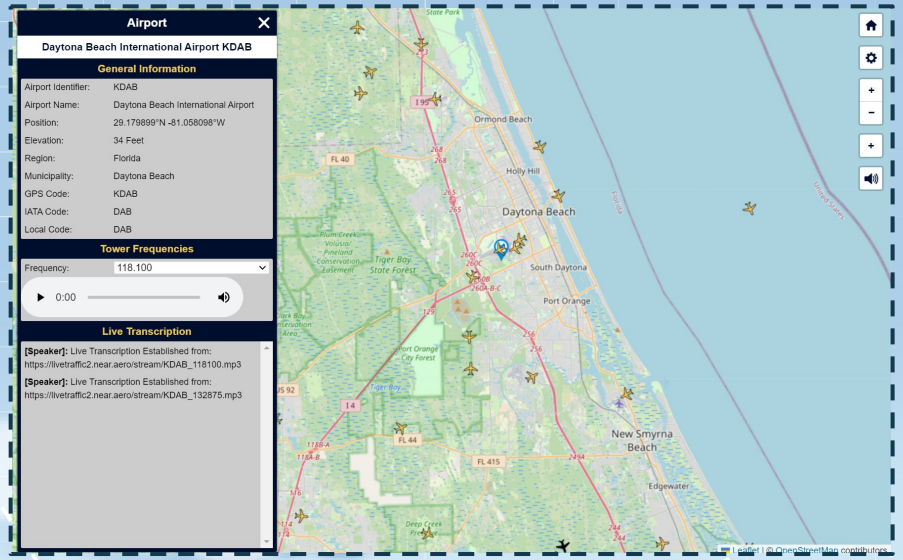




FREQUENCY SELECTION

Facelift of key web application, cleaning up the UI resulted in space now used to display transcriptions.

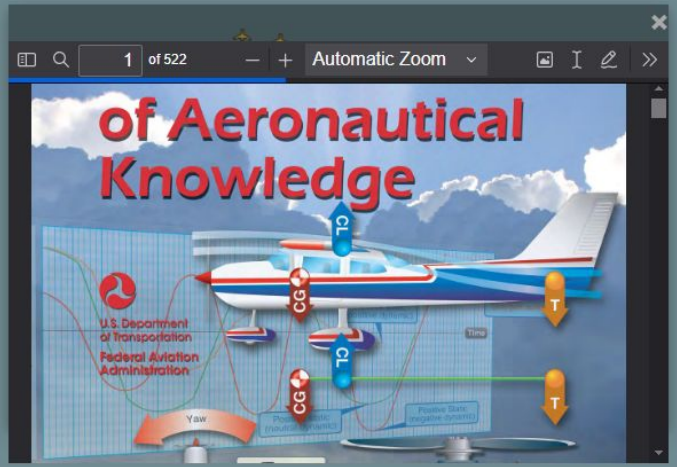




(Top) Frequency not yet selected,
(Left) currently displaying frequency source being used

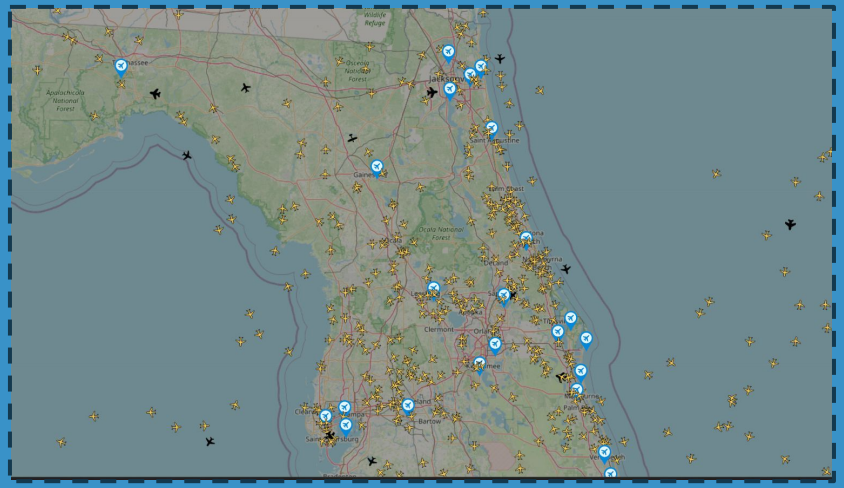
PILOT'S HANDBOOK

Implemented Pilots Handbook so users can have a reference tool when listening into ATC audio or to understand terms and concepts



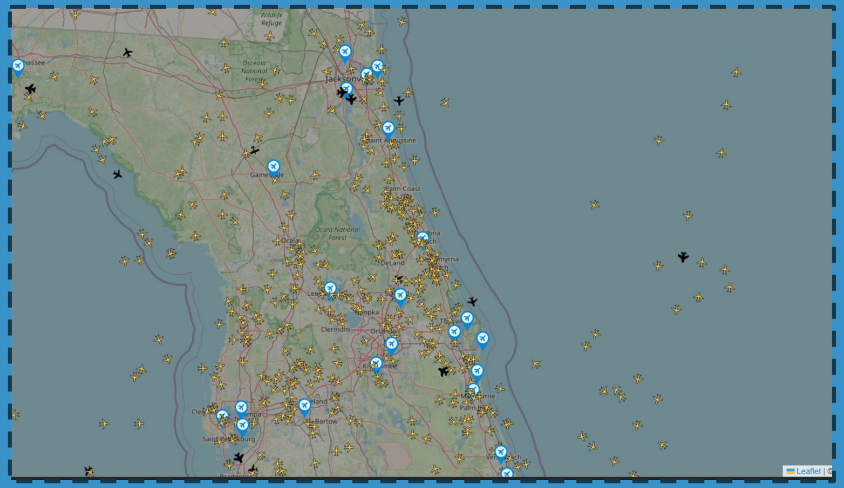
PLANE ICON QUERY

Connected database with frontend. This allows for the aircraft information to be queried from the database and displayed to the user by clicking an icon on the map.



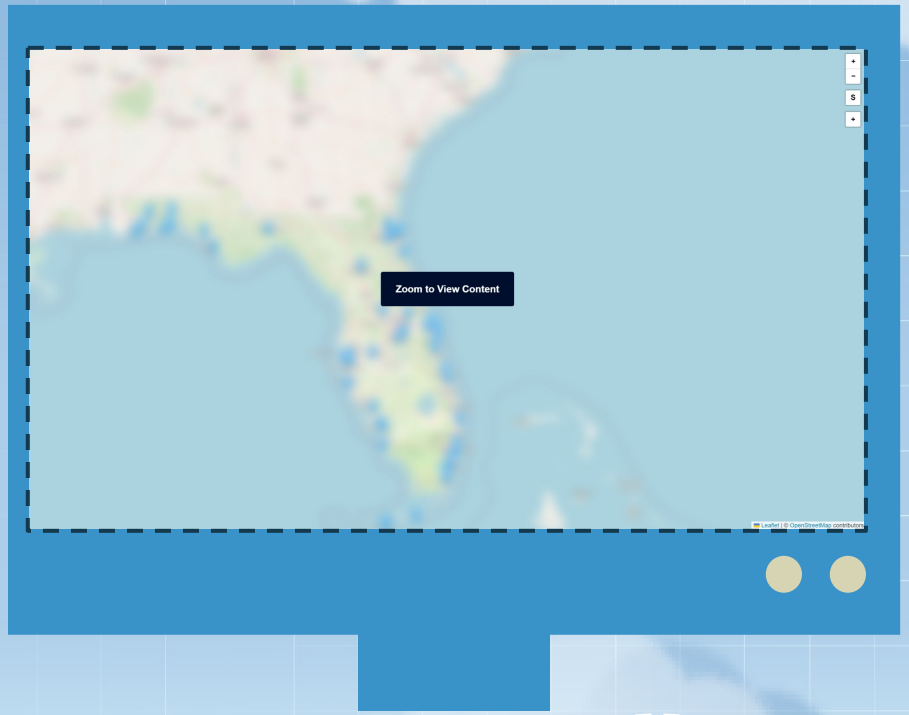
AIRPORT ICON QUERY

Connected database with frontend. This allows for the airport information to be queried from the database and displayed to the user by clicking an icon on the map.



OTHER NOTABLE FEATURES

Future expandability was kept in mind. The original application maintained a bounding box for planes across the state of Florida. Now the Web Application checks where the user is looking.



04

BACKEND

NeMo ASR and Database

NVIDIA NEMO

GOT ACCESS TO WORKING MODEL

- Got access to the most accurate model.
- Found a way to implement NeMo in the database

USE THE MODEL FOR MORE RESEARCH

- Figure out how to implement the model with the web application.

```
is TensorFlow binary is optimized to use available CPU instructions in performance-
critical operations.
To enable the following instructions: AVX2 AVX_VNNI FMA, in other operations, rebui
ld TensorFlow with the appropriate compiler flags.
2024-01-31 14:54:00.701160: W tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38]
 TF-TRT Warning: Could not find TensorRT
[NeMo I 2024-01-31 14:54:03 cloud:58] Found existing object /home/adamfitch/.cache/
torch/NeMo/NeMo_1.23.0rc0/QuartzNet15x5Base-En/2b066be39e9294d7100fb176ec817722/Qua
rtzNet15x5Base-En.nemo.
[NeMo I 2024-01-31 14:54:03 cloud:64] Re-using file from: /home/adamfitch/.cache/to
rch/NeMo/NeMo_1.23.0rc0/QuartzNet15x5Base-En/2b066be39e9294d7100fb176ec817722/Quart
zNet15x5Base-En.nemo
[NeMo I 2024-01-31 14:54:03 common:924] Instantiating model from pre-trained checkp
oint
[NeMo I 2024-01-31 14:54:04 features:289] PADDING: 16
[NeMo I 2024-01-31 14:54:04 save_restore_connector:249] Model EncDecCTCModel was su
ccessfully restored from /home/adamfitch/.cache/torch/NeMo/NeMo_1.23.0rc0/QuartzNet
15x5Base-En/2b066be39e9294d7100fb176ec817722/QuartzNet15x5Base-En.nemo.
Transcribing: 100%|[redacted]| 1/1 [00:01<00:00,  1.06s/it]
Audio in /home/adamfitch/NeMo/workingNemo/audio_files/gettysburg.wav was recognized
 as: four score and seven years ago our fathers brought forth on this continent a n
ew nation conceived in liberty and dedicated to the proposition that all men are cr
eated equal now we are engaged in a great civil war testing whether that nation or
any nation so conceived and so dedicated can long endure
adamfitch@adam-XPS-15-9520:~/NeMo/workingNemo$
```

DATABASE

Original Database

- Original database using sqllite connected with SQLAlchemy.
- Realized that it was only able to hold a certain amount of data for us.

```
…/asr-webapp  main !?
❯ flask --app source shell
Python 3.11.5 (main, Sep 11 2023, 13:54:46) [GCC 11.2.0] on linux
App: source
Instance: /home/adamfitch/GitHub/asr-webapp/instance
>>> aircraft = Communication(callsign = '12345');
>>> aircraft
<Communication 12345>
>>>
```

DATABASE AIRCRAFTS

- Decided to use mysql instead of sqllite.
- Established mysql database with sqlalchemy.
- Able to pull airplane information from opensky when webapp runs.

```
127.0.0.1 - - [06/Mar/2024 17:24:22] "GET /static/images/ui/close-icon
.svg HTTP/1.1" 404 -
127.0.0.1 - - [06/Mar/2024 17:24:22] "GET /static/images/ui/home-icon.
svg HTTP/1.1" 404 -
127.0.0.1 - - [06/Mar/2024 17:24:22] "GET /static/images/ui/settings-i
con.svg HTTP/1.1" 404 -
127.0.0.1 - - [06/Mar/2024 17:24:22] "GET /static/images/ui/audio-icon
.svg HTTP/1.1" 404 -
127.0.0.1 - - [06/Mar/2024 17:24:22] "POST /data/getMapLatLonBounds HT
TP/1.1" 200 -
127.0.0.1 - - [06/Mar/2024 17:24:22] "POST /data/getMapLatLonBounds HT
TP/1.1" 200 -
127.0.0.1 - - [06/Mar/2024 17:24:22] "GET /data/airports/FL HTTP/1.1"
200 -
127.0.0.1 - - [06/Mar/2024 17:24:22] "GET /static/images/markers/airpo
rt.svg HTTP/1.1" 304 -
127.0.0.1 - - [06/Mar/2024 17:24:23] "GET /data/plane_states HTTP/1.1"
 200 -
```

id	icao24	callsign	origin_country	time_position	last_contact	longitude	latitude	geo_altitude	on_ground	velocity	true_track	vertical_rate	squawk	position_source	category	created_at
1	ad4f1c	ERU957	United States	1713897599	1713897599	-81.4097	29.4419	891.54	0	52.67	167.59	-0.65	NULL	0	0	2024-04-23 18:40:15
2	a078e9	N514ND	United States	1713897601	1713897601	-81.1218	29.3806	0	0	33.6	78.32	-2.93	NULL	0	0	2024-04-23 18:40:15
3	a438fa	N371RA	United States	1713897599	1713897599	-81.6747	28.0279	1234.44	0	84.51	254.1	0.65	NULL	0	0	2024-04-23 18:40:15
4	a798c6	EJA589	United States	1713897600	1713897600	-79.9474	27.0111	1562.1	0	139.02	208.27	-7.48	NULL	0	0	2024-04-23 18:40:15
5	ace6b5	LFA683	United States	1713897689	1713897689	-82.0095	28.588	1363.98	0	70.93	23.96	-2.28	NULL	0	0	2024-04-23 18:40:15
6	a6fe41	N55NC	United States	1713897600	1713897600	-81.9621	28.0565	4221.48	0	161.87	65.8	-6.83	6431	0	0	2024-04-23 18:40:15
7	ab63f3	ERU833	United States	1713897599	1713897599	-81.2602	29.8058	1272.54	0	53.65	155.65	0.33	NULL	0	0	2024-04-23 18:40:15
8	ab4409	N116RW	United States	1713897599	1713897599	-82.2726	31.3889	10355.6	0	232.15	341.52	0.33	4026	0	0	2024-04-23 18:40:15
9	a35592	JBU591	United States	1713897599	1713897599	-82.4546	27.7901	914.4	0	106.3	236.85	0.33	3406	0	0	2024-04-23 18:40:15
10	ace6e2	AAL1138	United States	1713897599	1713897599	-81.6672	30.4662	358.14	0	86.77	131.15	13	NULL	0	1	2024-04-23 18:40:15
11	aa3199	N756FA	United States	1713897680	1713897680	-81.3794	28.5275	243.84	0	45.87	46.89	-1.63	4026	0	0	2024-04-23 18:40:15
12	a007dc	N10058	United States	1713897599	1713897599	-82.9829	27.8039	3684.26	0	94.98	105.39	0.33	NULL	0	0	2024-04-23 18:40:15
13	ab1628	SCW347	United States	1713897599	1713897599	-82.6205	30.6581	9128.76	0	244.79	143.6	0	7015	0	0	2024-04-23 18:40:15
14	a57b8b	SWA2956	United States	1713897680	1713897680	-82.8863	29.4428	7993.38	0	223.45	178.19	-12.35	6773	0	0	2024-04-23 18:40:15
15	aa56f8	UAL2668	United States	1713897419	1713897419	-82.5359	27.9734	NULL	1	11.83	186.88	NULL	1306	0	0	2024-04-23 18:40:15
16	a1b44b	N209JS	United States	1713897599	1713897600	-82.0741	28.4389	2125.98	0	57.15	166.46	0	NULL	0	0	2024-04-23 18:40:15
17	a91700	NWS3910	United States	1713897680	1713897680	-79.6666	27.864	6499.86	0	196.52	196.11	-10.08	NULL	0	1	2024-04-23 18:40:15
18	a234ef	ENY3346	United States	1713897599	1713897599	-81.8352	28.8195	10408.9	0	216.86	337.69	3.58	3525	0	0	2024-04-23 18:40:15
19	ae1439	VM714	United States	1713897599	1713897600	-81.1076	29.1685	168.02	0	65.82	65.84	-2.93	NULL	0	0	2024-04-23 18:40:15
20	ace764	NY630TT	United States	1713897599	1713897599	-81.3712	30.8892	9761.22	0	157.63	357.01	-0.33	NULL	0	0	2024-04-23 18:40:15
21	adfee1	PAT460	United States	1713897599	1713897600	-81.7052	28.8452	2766.06	0	127.68	134.84	0	NULL	0	13	2024-04-23 18:40:15
22	aae283	N8086R	United States	1713897599	1713897599	-82.3477	26.9313	1440.18	0	89.39	319.43	-2.93	NULL	0	0	2024-04-23 18:40:15
23	a844c7	JBU168	United States	1713897599	1713897599	-81.1365	29.2113	632.46	0	49.46	198.81	-0.33	NULL	0	0	2024-04-23 18:40:15
24	ab7715	JTL812	United States	1713897599	1713897600	-82.2169	27.7643	10294.6	0	241.85	163.38	-12.68	2425	0	0	2024-04-23 18:40:15
25	ada588	ERU979	United States	1713897599	1713897599	-81.2843	29.634	777.24	0	31.4	251.86	0.33	NULL	0	0	2024-04-23 18:40:15
26	a4dca4	DAL2149	United States	1713897680	1713897680	-81.0153	28.5302	9776.46	0	234.66	348.13	4.55	NULL	0	0	2024-04-23 18:40:15
27	a90439	LFA537	United States	1713897599	1713897599	-80.6527	28.1822	419.1	0	43.73	89.33	4.55	NULL	0	0	2024-04-23 18:40:15
28	a964a1	N704NL	United States	1713897599	1713897599	-80.7023	28.2775	1066.8	0	39.45	157.78	0	NULL	0	0	2024-04-23 18:40:15
29	a7d6a8	FFT3590	United States	1713897599	1713897600	-79.9643	27.8972	10355.6	0	241.53	11.55	4.55	NULL	0	0	2024-04-23 18:40:15
30	ab9a32	DAL759	United States	1713897441	1713897441	-82.5424	27.9601	22.86	0	75.65	1.56	-4.88	3530	0	1	2024-04-23 18:40:15
31	3c4a2a	DLH646	Germany	1713897599	1713897599	-79.7967	28.5826	11353.8	0	218.73	234.12	0	NULL	0	0	2024-04-23 18:40:15
32	aaca75	SCX3029	United States	1713897599	1713897599	-83.3507	29.6766	12542.5	0	215.25	323.65	2.93	NULL	0	0	2024-04-23 18:40:15
33	a6ec95	VJA545	United States	1713897599	1713897600	-83.2888	27.2197	12367.3	0	270.6	101.76	-5.53	2671	0	0	2024-04-23 18:40:15
34	a1e81c	N2575G	United States	1713897599	1713897599	-81.6374	28.4652	746.76	0	48.64	259.44	3.58	NULL	0	0	2024-04-23 18:40:15
35	a7b0c4	JBU2593	United States	1713897680	1713897680	-80.9878	28.7073	10729	0	229.88	157.22	-1.95	4771	0	0	2024-04-23 18:40:15
36	a8dcae	NKS2047	United States	1713897599	1713897600	-81.2711	28.7166	3139.44	0	150.21	353.31	10.4	NULL	0	0	2024-04-23 18:40:15
37	3e8b2	EPI599	United States	1713897599	1713897599	-80.9025	28.9836	678.18	0	43.18	158.33	5.85	NULL	0	0	2024-04-23 18:40:15
38	a1ae05	SWA4567	United States	1713897680	1713897680	-82.0925	29.9882	10995.7	0	241.72	170.2	0	6263	0	0	2024-04-23 18:40:15
39	a5cc63	N473BL	United States	1713897599	1713897600	-81.7346	28.8682	274.32	0	52.81	317.76	-0.33	NULL	0	0	2024-04-23 18:40:15
40	a7135f	DAL1323	United States	1713897599	1713897599	-83.3753	29.3071	11635.7	0	252.85	150.4	0	NULL	0	0	2024-04-23 18:40:15
41	a0326e	N1111J	United States	1713897680	1713897680	-81.7643	30.3994	2522.22	0	138.86	106.35	-12.03	NULL	0	0	2024-04-23 18:40:15
42	a27e50	JCM26	United States	1713897599	1713897599	-81.8116	28.5651	5661.66	0	169.52	257.74	13.33	NULL	0	0	2024-04-23 18:40:15
43	a916cc	LFA542	United States	1713897599	1713897599	-80.7413	28.299	1203.96	0	54.3	154.16	0	NULL	0	0	2024-04-23 18:40:15
44	ad4eb5	AAL2330	United States	1713897583	1713897583	-82.5424	27.9599	15.24	0	77.72	1.9	-4.23	2411	0	0	2024-04-23 18:40:15
45	ab652a	N833TB	United States	1713897685	1713897565	-81.1006	27.1908	2331.72	0	56.48	221.68	-0.65	NULL	0	0	2024-04-23 18:40:15
46	adf505	N999KT	United States	1713897599	1713897600	-80.9680	29.7436	4943.38	0	183.96	167.13	-0.33	2001	0	0	2024-04-23 18:40:15
47	a3db5e	DAL848	United States	1713897496	1713897525	-81.4705	26.9858	2796.54	0	148.5	155.65	-5.85	7107	0	4	2024-04-23 18:40:15
48	a7c522	VJA68	United States	1713897599	1713897600	-82.6743	28.8896	13582.6	0	208.48	324.03	-0.33	4737	0	0	2024-04-23 18:40:15
49	a1e88f	MXY532	United States	1713897599	1713897599	-82.5477	27.814	868.68	0	91.66	2.57	-2.93	2007	0	0	2024-04-23 18:40:15
50	a38b9d	N32769	United States	1713897590	1713897590	-82.3926	27.1237	982.98	0	46.71	352.41	3.9	3170	0	0	2024-04-23 18:40:15
51	ac7256	AAL1572	United States	1713897680	1713897680	-81.4086	30.7462	10988	0	227.64	357.28	-0.33	NULL	0	0	2024-04-23 18:40:15
52	a2d58d	N282BL	United States	1713897680	1713897680	-81.7625	28.2289	1356.36	0	55.49	342.74	0	NULL	0	0	2024-04-23 18:40:15
53	a3571c	EJA314	United States	1713897503	1713897503	-81.5438	30.3082	228.6	0	58.9	64.11	-5.85	NULL	0	0	2024-04-23 18:40:15
54	a8de7d	DAL1030	United States	1713897599	1713897599	-82.1901	31.8926	10988	0	225.84	340.57	0	NULL	0	0	2024-04-23 18:40:15
55	a7626b	EJA575	United States	1713897689	1713897689	-80.4144	28.4334	10088.9	0	226.31	244.27	-0.65	NULL	0	0	2024-04-23 18:40:15
56	a9aee9	N723CF	United States	1713897594	1713897594	-81.7282	27.2651	2148.84	0	74.34	131.63	0	6314	0	0	2024-04-23 18:40:15
57	ad4389	CNS247	United States	1713897540	1713897544	-80.7058	27.8693	1638.3	0	117.38	118.25	-7.15	NULL	0	0	2024-04-23 18:40:15

DATABASE AIRPORTS

- Took from an excel file
- Established mysql database with sqlalchemy.
- Able to pull airport information from opensky when webapp runs.

id	ident	type	name	latitude	longitude	elevation	continent	country_name	iso_country	region_name	iso_region	local_region	municipality	scheduled_service	gps_code	iata_code	local_code	home_link	wikipedia_link	keywords	score
1	KLAX	large_airport	Los Angeles International Airport	33.9425	-118.408	125	NULL	United States	NULL	California	NULL	CA	Los Angeles	NULL	KLAX	LAX	LAX	https://www.flylax.com/	NULL	NULL	NULL
2	KORD	large_airport	Chicago O'Hare International Airport	41.9786	-87.9048	672	NULL	United States	NULL	Illinois	NULL	IL	Chicago	NULL	KORD	ORD	ORD	https://www.flychicago.com/ohare/home/pages/default.aspx	NULL	NULL	NULL
3	KJFK	large_airport	John F Kennedy International Airport	40.6394	-73.7785	13	NULL	United States	NULL	New York	NULL	NY	New York	NULL	KJFK	JFK	JFK	https://www.jfkairport.com/	NULL	NULL	NULL
4	KATL	large_airport	Hartsfield Jackson Atlanta International Airport	33.6367	-84.4281	1026	NULL	United States	NULL	Georgia	NULL	GA	Atlanta	NULL	KATL	ATL	ATL	http://www.atlanta-airport.com/	NULL	NULL	NULL
5	KSFO	large_airport	San Francisco International Airport	37.619	-122.375	13	NULL	United States	NULL	California	NULL	CA	San Francisco	NULL	KSFO	SFO	SFO	http://www.flysfo.com/	NULL	NULL	NULL
6	KEWR	large_airport	Newark Liberty International Airport	40.6925	-74.1687	18	NULL	United States	NULL	New Jersey	NULL	NJ	Newark	NULL	KEWR	EWR	EWR	http://www.panyn.gov/CommutingTravel/airports/html/newarkliberty.html	NULL	NULL	NULL
7	KDFW	large_airport	Dallas Fort Worth International Airport	32.8968	-97.0380	607	NULL	United States	NULL	Texas	NULL	TX	Dallas-Fort Worth	NULL	KDFW	DFW	DFW	https://www.dfwairport.com/	NULL	NULL	NULL
8	KLAS	large_airport	Harry Reid International Airport	36.0834	-115.152	2181	NULL	United States	NULL	Nevada	NULL	NV	Las Vegas	NULL	KLAS	LAS	LAS	https://www.harryreidairport.com/	NULL	NULL	NULL
9	KMCO	large_airport	Orlando International Airport	28.4294	-81.309	96	NULL	United States	NULL	Florida	NULL	FL	Orlando	NULL	KMCO	MCO	MCO	http://www.orlandoairports.net/	NULL	NULL	NULL
10	KDEN	large_airport	Denver International Airport	39.8617	-104.673	5431	NULL	United States	NULL	Colorado	NULL	CO	Denver	NULL	KDEN	DEN	DEN	http://www.flydenver.com/	NULL	NULL	NULL
11	KLGA	large_airport	La Guardia Airport	40.7772	-73.8726	21	NULL	United States	NULL	New York	NULL	NY	New York	NULL	KLGA	LGA	LGA	https://www.laguardiaairport.com/	NULL	NULL	NULL
12	KMIA	large_airport	Miami International Airport	25.7932	-80.2906	8	NULL	United States	NULL	Florida	NULL	FL	Miami	NULL	KMIA	MIA	MIA	http://www.miami-airport.com/	NULL	NULL	NULL
13	KIAD	large_airport	Washington Dulles International Airport	38.9445	-77.4558	313	NULL	United States	NULL	Virginia	NULL	VA	Dulles	NULL	KIAD	IAD	IAD	http://www.mwaa.com/dulles/	NULL	NULL	NULL
14	KPHX	large_airport	Phoenix Sky Harbor International Airport	33.4353	-112.086	1135	NULL	United States	NULL	Arizona	NULL	AZ	Phoenix	NULL	KPHX	PHX	PHX	http://phoenix.gov/skyharborinfo/airport/	NULL	NULL	NULL
15	KSEA	large_airport	Seattle'Tacoma International Airport	47.4502	-122.312	433	NULL	United States	NULL	Washington	NULL	WA	Seattle	NULL	KSEA	SEA	SEA	NULL	NULL	NULL	NULL
16	KBOS	large_airport	Logan International Airport	42.3643	-71.0052	20	NULL	United States	NULL	Massachusetts	NULL	MA	Boston	NULL	KBOS	BOS	BOS	http://www.massport.com/logan/	NULL	NULL	NULL
17	KPHL	large_airport	Philadelphia International Airport	39.8719	-75.2411	36	NULL	United States	NULL	Pennsylvania	NULL	PA	Philadelphia	NULL	KPHL	PHL	PHL	http://www.phl.org/	NULL	NULL	NULL
18	KCLT	large_airport	Charlotte Douglas International Airport	35.2214	-80.9431	748	NULL	United States	NULL	North Carolina	NULL	NC	Charlotte	NULL	KCLT	CLT	CLT	http://www.charlottesairport.com/	NULL	NULL	NULL
19	KIAH	large_airport	George Bush Intercontinental Houston Airport	29.9844	-95.3414	97	NULL	United States	NULL	Texas	NULL	TX	Houston	NULL	KIAH	IAH	IAH	http://www.fly2houston.com/iah	NULL	NULL	NULL
20	KDTW	large_airport	Detroit Metropolitan Wayne County Airport	42.2124	-83.3534	645	NULL	United States	NULL	Michigan	NULL	MI	Detroit	NULL	KDTW	DTW	DTW	http://www.metroairport.com/	NULL	NULL	NULL
21	KDCA	large_airport	Ronald Reagan Washington National Airport	38.8521	-77.0377	15	NULL	United States	NULL	District of Columbia	NULL	DC	Washington	NULL	KDCA	DCA	DCA	http://www.flyreagan.com/dca/reagan-national-airport	NULL	NULL	NULL
22	KMSP	large_airport	Minneapolis'Saint Paul International Airport / Wold'Chamberlain Field	44.882	-93.2218	841	NULL	United States	NULL	Minnesota	NULL	MN	Minneapolis	NULL	KMSP	MSP	MSP	http://www.mspairport.com/	NULL	NULL	NULL
23	KSLC	large_airport	Salt Lake City International Airport	40.7884	-111.98	4227	NULL	United States	NULL	Utah	NULL	UT	Salt Lake City	NULL	KSLC	SLC	SLC	NULL	NULL	NULL	NULL
24	KFLL	large_airport	Fort Lauderdale Hollywood International Airport	26.0726	-80.1527	9	NULL	United States	NULL	Florida	NULL	FL	Fort Lauderdale	NULL	KFLL	FLL	FLL	http://www.broward.org/airport	NULL	NULL	NULL
25	KMDW	large_airport	Chicago Midway International Airport	41.786	-87.7524	620	NULL	United States	NULL	Illinois	NULL	IL	Chicago	NULL	KMDW	MDW	MDW	https://www.flychicago.com/midway/home/pages/default.aspx	NULL	NULL	NULL
26	KSAN	large_airport	San Diego International Airport	32.7336	-117.19	17	NULL	United States	NULL	California	NULL	CA	San Diego	NULL	KSAN	SAN	SAN	http://www.san.org/	NULL	NULL	NULL
27	KBWI	large_airport	Baltimore/Washington International Thurgood Marshall Airport	39.1754	-76.6683	146	NULL	United States	NULL	Maryland	NULL	MD	Baltimore	NULL	KBWI	BWI	BWI	https://www.bwiairport.com/	NULL	NULL	NULL
28	KSTL	large_airport	St Louis Lambert International Airport	38.7487	-90.37	618	NULL	United States	NULL	Missouri	NULL	MO	St Louis	NULL	KSTL	STL	STL	https://www.flystl.com/	NULL	NULL	NULL
29	PHNL	large_airport	Daniel K Inouye International Airport	21.3256	-157.924	13	NULL	United States	NULL	Hawaii	NULL	HI	Honolulu	NULL	PHNL	HNL	HNL	http://airports.hawaii.gov/hnl/	NULL	NULL	NULL
30	KPDX	large_airport	Portland International Airport	45.5887	-122.598	31	NULL	United States	NULL	Oregon	NULL	OR	Portland	NULL	KPDX	PDX	PDX	NULL	NULL	NULL	NULL
31	KMSY	large_airport	Louis Armstrong New Orleans International Airport	29.9934	-90.258	4	NULL	United States	NULL	Louisiana	NULL	LA	New Orleans	NULL	KMSY	MSY	MSY	NULL	NULL	NULL	NULL
32	KTPA	large_airport	Tampa International Airport	27.9756	-82.5332	26	NULL	United States	NULL	Florida	NULL	FL	Tampa	NULL	KTPA	TPA	TPA	NULL	NULL	NULL	NULL
33	KBNA	large_airport	Nashville International Airport	36.1245	-86.6782	599	NULL	United States	NULL	Tennessee	NULL	TN	Nashville	NULL	KBNA	BNA	BNA	NULL	NULL	NULL	NULL
34	KCVG	large_airport	Cincinnati Northern Kentucky International Airport	39.0488	-84.6678	896	NULL	United States	NULL	Kentucky	NULL	KY	Cincinnati / Covington	NULL	KCVG	CVG	CVG	NULL	NULL	NULL	NULL
35	KAUS	large_airport	Austin Bergstrom International Airport	30.1975	-97.662	542	NULL	United States	NULL	Texas	NULL	TX	Austin	NULL	KAUS	AUS	AUS	http://www.ci.austin.tx.us/austinairport/	NULL	NULL	NULL
36	KRDU	large_airport	Raleigh Durham International Airport	35.8776	-78.7875	435	NULL	United States	NULL	North Carolina	NULL	NC	Raleigh/Durham	NULL	KRDU	RDU	RDU	NULL	NULL	NULL	NULL
37	KPIT	large_airport	Pittsburgh International Airport	40.4915	-80.2329	1203	NULL	United States	NULL	Pennsylvania	NULL	PA	Pittsburgh	NULL	KPIT	PIT	PIT	NULL	NULL	NULL	NULL
38	KSJC	large_airport	Norman Y. Mineta San Jose International Airport	37.3625	-121.929	62	NULL	United States	NULL	California	NULL	CA	San Jose	NULL	KSJC	SJC	SJC	https://www.flysanjose.com/	NULL	NULL	NULL
39	KOAK	large_airport	Metropolitan Oakland International Airport	37.7213	-122.221	9	NULL	United States	NULL	California	NULL	CA	Oakland	NULL	KOAK	OAK	OAK	http://www.oaklandairport.com/	NULL	NULL	NULL
40	KMCI	large_airport	Kansas City International Airport	39.2976	-94.7139	1026	NULL	United States	NULL	Missouri	NULL	MO	Kansas City	NULL	KMCI	MCI	MCI	http://flykci.com/	NULL	NULL	NULL
41	KSAT	large_airport	San Antonio International Airport	29.5337	-98.4698	809	NULL	United States	NULL	Texas	NULL	TX	San Antonio	NULL	KSAT	SAT	SAT	https://www.sanantonio.gov/aviation	NULL	NULL	NULL
42	KMEM	large_airport	Memphis International Airport	35.0424	-89.9767	341	NULL	United States	NULL	Tennessee	NULL	TN	Memphis	NULL	KMEM	MEM	MEM	NULL	NULL	NULL	NULL
43	KSNA	large_airport	John Wayne Orange County International Airport	33.6757	-117.868	56	NULL	United States	NULL	California	NULL	CA	Santa Ana	NULL	KSNA	SNA	SNA	http://www.ocair.com/	NULL	NULL	NULL
45	KCLE	large_airport	Cleveland Hopkins International Airport	41.4117	-81.8498	791	NULL	United States	NULL	Ohio	NULL	OH	Cleveland	NULL	KCLE	CLE	CLE	http://www.clevelandairport.com/	NULL	NULL	NULL
46	KIND	large_airport	Indianapolis International Airport	39.7173	-86.2944	797	NULL	United States	NULL	Indiana	NULL	IN	Indianapolis	NULL	KIND	IND	IND	http://www.indianapolisairport.com/	NULL	NULL	NULL
47	KCMH	large_airport	John Glenn Columbus International Airport	39.998	-82.8919	815	NULL	United States	NULL	Ohio	NULL	OH	Columbus	NULL	KCMH	CMH	CMH	https://flycolumbus.com/	NULL	NULL	NULL
48	KMKE	large_airport	General Mitchell International Airport	42.9472	-87.8966	723	NULL	United States	NULL	Wisconsin	NULL	WI	Milwaukee	NULL	KMKE	MKE	MKE	NULL	NULL	NULL	NULL
52	KJAX	large_airport	Jacksonville International Airport	30.4942	-81.6879	30	NULL	United States	NULL	Florida	NULL	FL	Jacksonville	NULL	KJAX	JAX	JAX	NULL	NULL	NULL	NULL
54	KBUF	large_airport	Buffalo Niagara International Airport	42.9405	-78.7322	728	NULL	United States	NULL	New York	NULL	NY	Buffalo	NULL	KBUF	BUF	BUF	NULL	NULL	NULL	NULL
56	PANC	large_airport	Ted Stevens Anchorage International Airport	61.1744	-149.996	152	NULL	United States	NULL	Alaska	NULL	AK	Anchorage	NULL	PANC	ANC	ANC	NULL	NULL	NULL	NULL
58	KSMF	large_airport	Sacramento International Airport	38.6954	-121.591	27	NULL	United States	NULL	California	NULL	CA	Sacramento	NULL	KSMF	SMF	SMF	NULL	NULL	NULL	NULL
59	KPBI	large_airport	Palm Beach International Airport	26.6832	-80.0956	19	NULL	United States	NULL	Florida	NULL	FL	West Palm Beach	NULL	KPBI	PBI	PBI	NULL	NULL	NULL	NULL
60	KOMA	large_airport	Omaha Eppley Airfield	41.3032	-95.8941	984	NULL	United States	NULL	Nebraska	NULL	NE	Omaha	NULL	KOMA	OMA	OMA	NULL	NULL	NULL	NULL
64	KPVD	large_airport	Theodore Francis Green State Airport	41.725	-71.4257	55	NULL	United States	NULL	Rhode Island	NULL	RI	Warwick	NULL	KPVD	PVD	PVD	NULL	NULL	NULL	NULL
65	KSDF	large_airport	Louisville Muhammad Ali International Airport	38.1744	-85.736	501	NULL	United States	NULL	Kentucky	NULL	KY	Louisville	NULL	KSDF	SDF	SDF	http://flyladsville.com	NULL	NULL	NULL
66	KRNO	large_airport	Reno Tahoe International Airport	39.4991	-119.768	4415	NULL	United States	NULL	Nevada	NULL	NV	Reno	NULL	KRNO	RNO	RNO	NULL	NULL	NULL	NULL
69	KSAV	large_airport	Savannah Hilton Head International Airport	32.1276	-81.2021	50	NULL	United States	NULL	Georgia	NULL	GA	Savannah	NULL	KSAV	SAV	SAV	NULL	NULL	NULL	NULL
70	KRIC	large_airport	Richmond International Airport	37.5052	-77.3197	167	NULL	United States	NULL	Virginia	NULL	VA	Richmond	NULL	KRIC	RIC	RIC	NULL	NULL	NULL	NULL
72	KRSW	large_airport	Southwest Florida International Airport	26.5362	-81.7552	30	NULL	United States	NULL	Florida	NULL	FL	Fort Myers	NULL	KRSW	RSW	RSW	http://www.flylcpa.com/	NULL	NULL	NULL
75	KONT	large_airport	Ontario International Airport	34.056	-117.601	944	NULL	United States	NULL	California	NULL	CA	Ontario	NULL	KONT	ONT	ONT	NULL	NULL	NULL	NULL
79	KSYR	large_airport	Syracuse Hancock International Airport	43.1112	-76.3963	421	NULL	United States	NULL	New York	NULL	NY	Syracuse	NULL	KSYR	SYR	SYR	http://www.syrairport.org/	NULL	NULL	NULL
82	KTUL	large_airport	Tulsa International Airport	36.1984	-95.8881	677	NULL	United States	NULL	Oklahoma	NULL	OK	Tulsa	NULL	KTUL	TUL	TUL	NULL	NULL	NULL	NULL
89	KPWM	large_airport	Portland International Airport	43.6462	-70.3093	76	NULL	United States	NULL	Maine	NULL	ME	Portland	NULL	KPWM	PWM	PWM	NULL	NULL	NULL	NULL
131	KSFB	large_airport	Orlando Sanford International Airport	28.7776	-81.2375	55	NULL	United States	NULL	Florida	NULL	FL	Orlando	NULL	KSFB	SFB	SFB	NULL	NULL	NULL	NULL
141	KCMA	large_airport	Camarillo International Airport	34.2137	-119.094	77	NULL	United States	NULL	California	NULL	CA	Camarillo	NULL	KCMA	NULL	CMA	NULL	NULL	NULL	NULL
152	PAFA	large_airport	Fairbanks International Airport	64.8151	-147.856	439	NULL	United States	NULL	Alaska	NULL	AK	Fairbanks	NULL	PAFA	FAI	FAI	NULL	NULL	NULL	NULL
161	KADW	large_airport	Joint Base Andrews	38.8108	-76.867	208	NULL	United States	NULL	Maryland	NULL	MD	Camp Springs	NULL	KADW	ADW	ADW	http://www.jba.af.mil/	NULL	NULL	NULL

SEARCH FUNCTION

- Created a search function to locate aircraft.
- Connects database with search button on webapp.

```
['AAL1783', '2024-04-07', '2024-04-11']
Connection to MySQL database successful!
(130, 'a657bf', 'AAL1783 ', 'United States', 1712526286, 1712526286, -81.0402, 30.9324,
10820.4, 0, 241.52, 186.97, 0.0, '2364', 0, 0, datetime.datetime(2024, 4, 7, 21, 44, 56)
)
(450, 'a0fea6', 'AAL1783 ', 'United States', 1712700799, 1712700799, -81.3271, 28.4608,
106.68, 0, 73.05, 179.6, -4.23, '1703', 0, 0, datetime.datetime(2024, 4, 9, 22, 14, 35))
```

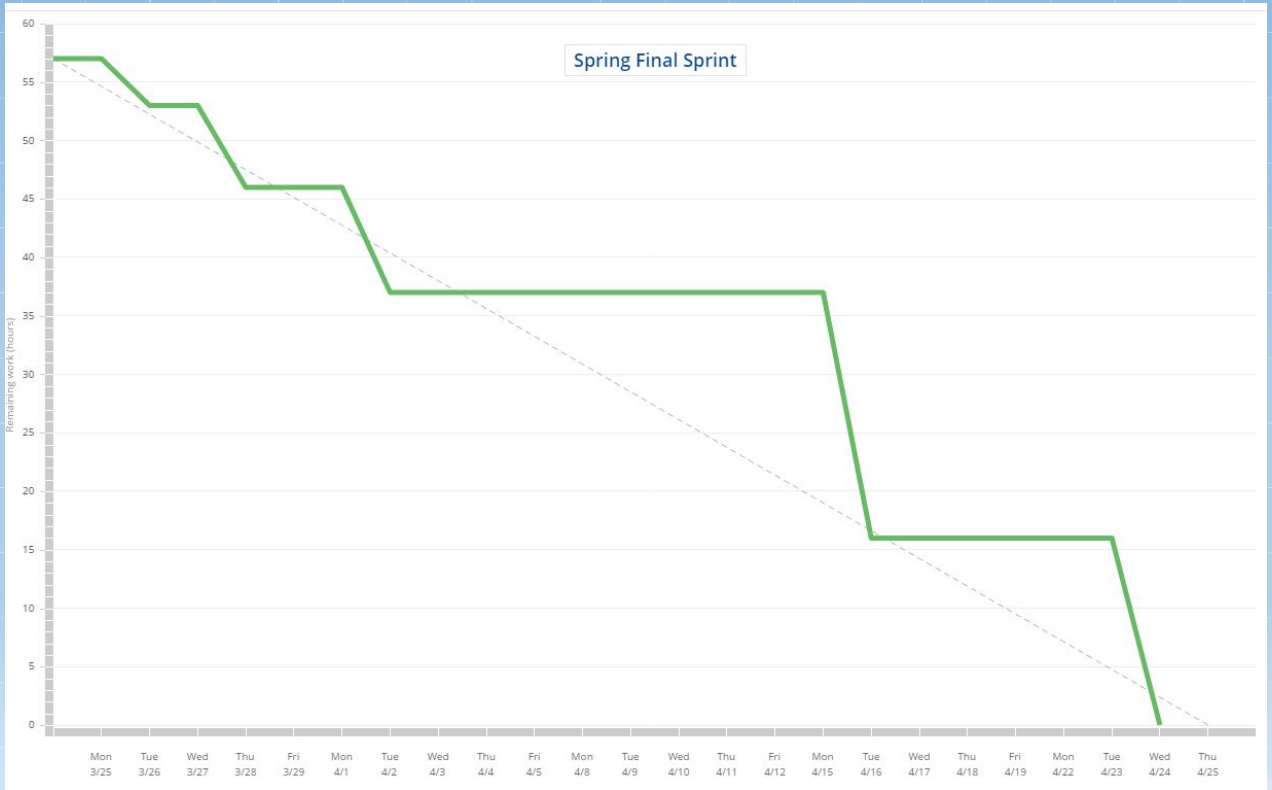
FUTURE BACKEND DEVELOPMENT

- Create “Nemo Listener” Function
- Train Nemo Model for 90% >= accuracy
- Data Grouping according to Take-off and Landing (Flights)

```
darianhop@DESKTOP-GB90SCJ: /mnt/c/Nemo
100% [.....................................................................] 71087043 / 71087043[NeMo I 2023-11-16 15
:30:35 common:913] Instantiating model from pre-trained checkpoint
[NeMo I 2023-11-16 15:30:36 features:289] PADDING: 16
[NeMo I 2023-11-16 15:30:37 save_restore_connector:249] Model EncDecCTCModel was successfully restored from /home/darian
hop/.cache/torch/NeMo/NeMo_1.21.0rc0/QuartzNet15x5Base-En/2b066be39e9294d7100fb176ec817722/QuartzNet15x5Base-En.nemo.
Traceback (most recent call last):
  File "/mnt/c/Nemo/TextFile1.py", line 17, in <module>
    files = [os.path.join('./voice_files/OSR_us_000_0010_8k.wav')]
NameError: name 'os' is not defined
(nemo) darianhop@DESKTOP-GB90SCJ:/mnt/c/Nemo$ python TextFile1.py
[NeMo I 2023-11-16 15:37:41 cloud:58] Found existing object /home/darianhop/.cache/torch/NeMo/NeMo_1.21.0rc0/QuartzNet15
x5Base-En/2b066be39e9294d7100fb176ec817722/QuartzNet15x5Base-En.nemo.
[NeMo I 2023-11-16 15:37:41 cloud:64] Re-using file from: /home/darianhop/.cache/torch/NeMo/NeMo_1.21.0rc0/QuartzNet15x5
Base-En/2b066be39e9294d7100fb176ec817722/QuartzNet15x5Base-En.nemo
[NeMo I 2023-11-16 15:37:41 common:913] Instantiating model from pre-trained checkpoint
[NeMo I 2023-11-16 15:37:42 features:289] PADDING: 16
[NeMo I 2023-11-16 15:37:42 save_restore_connector:249] Model EncDecCTCModel was successfully restored from /home/darian
hop/.cache/torch/NeMo/NeMo_1.21.0rc0/QuartzNet15x5Base-En/2b066be39e9294d7100fb176ec817722/QuartzNet15x5Base-En.nemo.
Transcribing:   0%|                                                                                  | 0/1 [00:00<?, ?it/s]
[NeMo W 2023-11-16 15:37:43 nemo_logging:349] /home/darianhop/miniconda3/envs/nemo/lib/python3.10/site-packages/torch/nn
/modules/conv.py:306: UserWarning: Applied workaround for CuDNN issue, install nvrtc.so (Triggered internally at /opt/co
nda/conda-bld/pytorch_1695392020201/work/aten/src/ATen/native/cudnn/Conv_v8.cpp:80.)
      return F.conv1d(input, weight, bias, self.stride,

Transcribing: 100%|[redacted]| 1/1 [00:00<00:00,  1.76it/s]
Audio in ./voice_files/OSR_us_000_0010_8k.wav was recognized as: the birch canoe slid on the smooth planks glue the shea
t to the dark blue background it is easy to tell the depth over well these days a chicken legg ey raredish rice is often
 served in roundbowls the juice of lemons makes fine punch the box was done beside the park truck the hogs ere fed chopp
ed corn and garbage four hours of study work faced us a large size in stockings is hard to sell
(nemo) darianhop@DESKTOP-GB90SCJ:/mnt/c/Nemo$
```

BURNDOWN


Spring Final Sprint
Remaining work (hours)
60
55
50
45
40
35
30
25
20
15
10
5
0
Mon 3/25
Tue 3/26
Wed 3/27
Thu 3/28
Fri 3/29
Mon 4/1
Tue 4/2
Wed 4/3
Thu 4/4
Fri 4/5
Mon 4/8
Tue 4/9
Wed 4/10
Thu 4/11
Fri 4/12
Mon 4/15
Tue 4/16
Wed 4/17
Thu 4/18
Fri 4/19
Mon 4/22
Tue 4/23
Wed 4/24
Thu 4/25

PREPARING FOR THE FUTURE

MODULARITY

- Ensuring that the application is easy to pick up and learn to continue iteration

DOCUMENTATION

- Ensuring our portion of the of work over the last year is well documented

Q&A