NEMO DEMO

Spring - 2nd Sprint

THE TEAM

Taylor Sumlin	Scrum Master, Frontend Developer
Maegan Lucas	Frontend Developer
Maxwell Moolchan	Frontend Developer
Adam Fitch	Backend Developer
Darian Hopkins	Backend Developer

AGENDA

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

02
SINCE LAST SPRINT
Accomplishments since last sprint.

03
FRONTEND
An overview of the frontend changes.

04
BACKEND
An overview of the backend developments.

05
TIMELINE
Planned tasks for the future.

06
LESSONS LEARNED
Lessons learned throughout the sprint.

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 LAST SPRINT

- Heavy Frontend Development
- Successful integration of database & web application

BUDGET

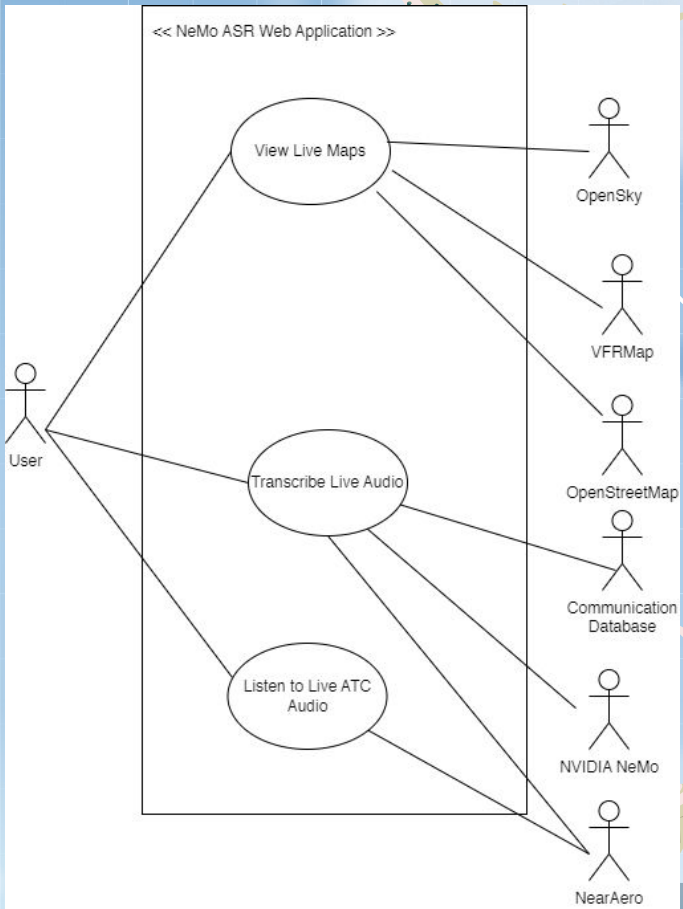
We currently use only open-source software.

Future Budget:

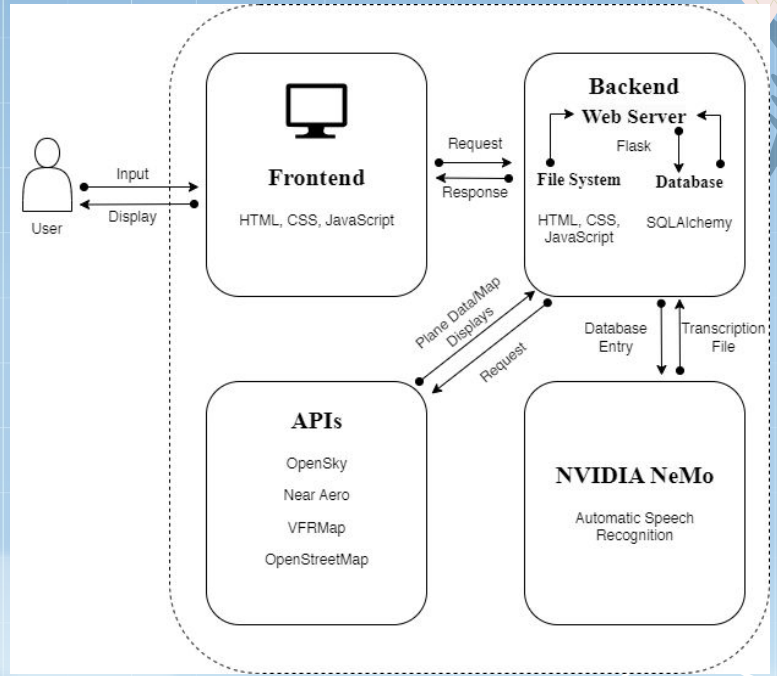
Due to API difficulties, there is a possibility that commercial software will be acquired in the future. If this becomes the case, we will have to consult Dr. Liu on an official budget.

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

SYSTEM OVERVIEW



SYSTEM ARCHITECTURE



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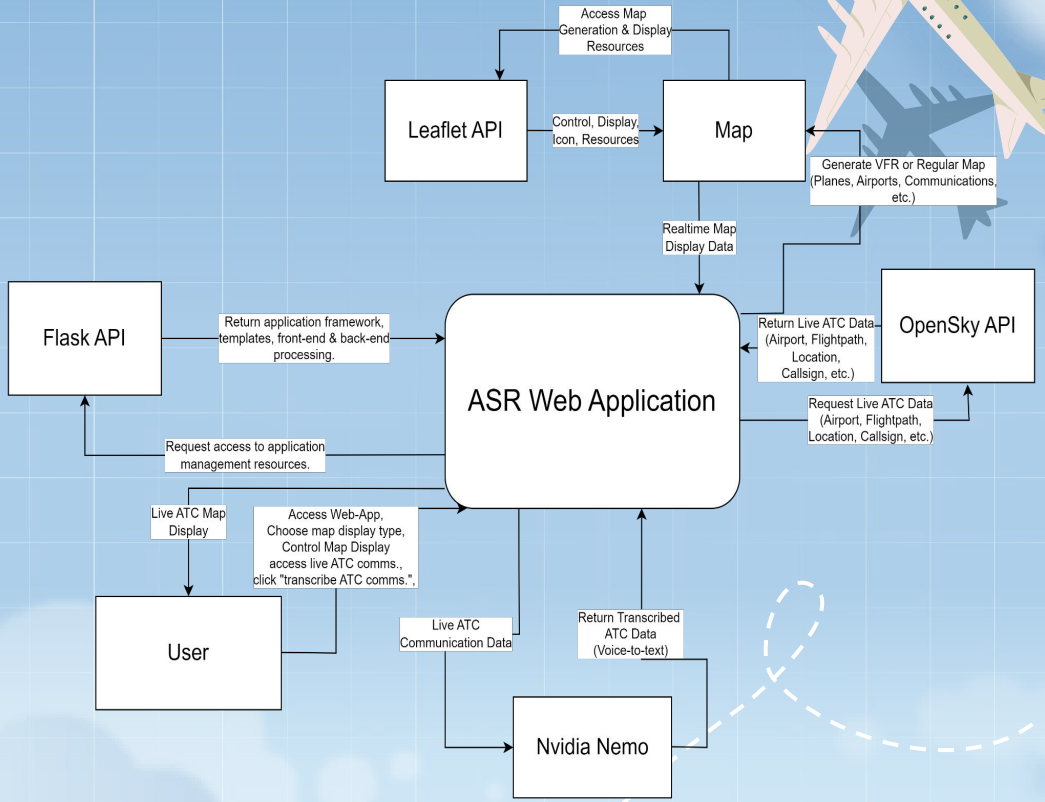

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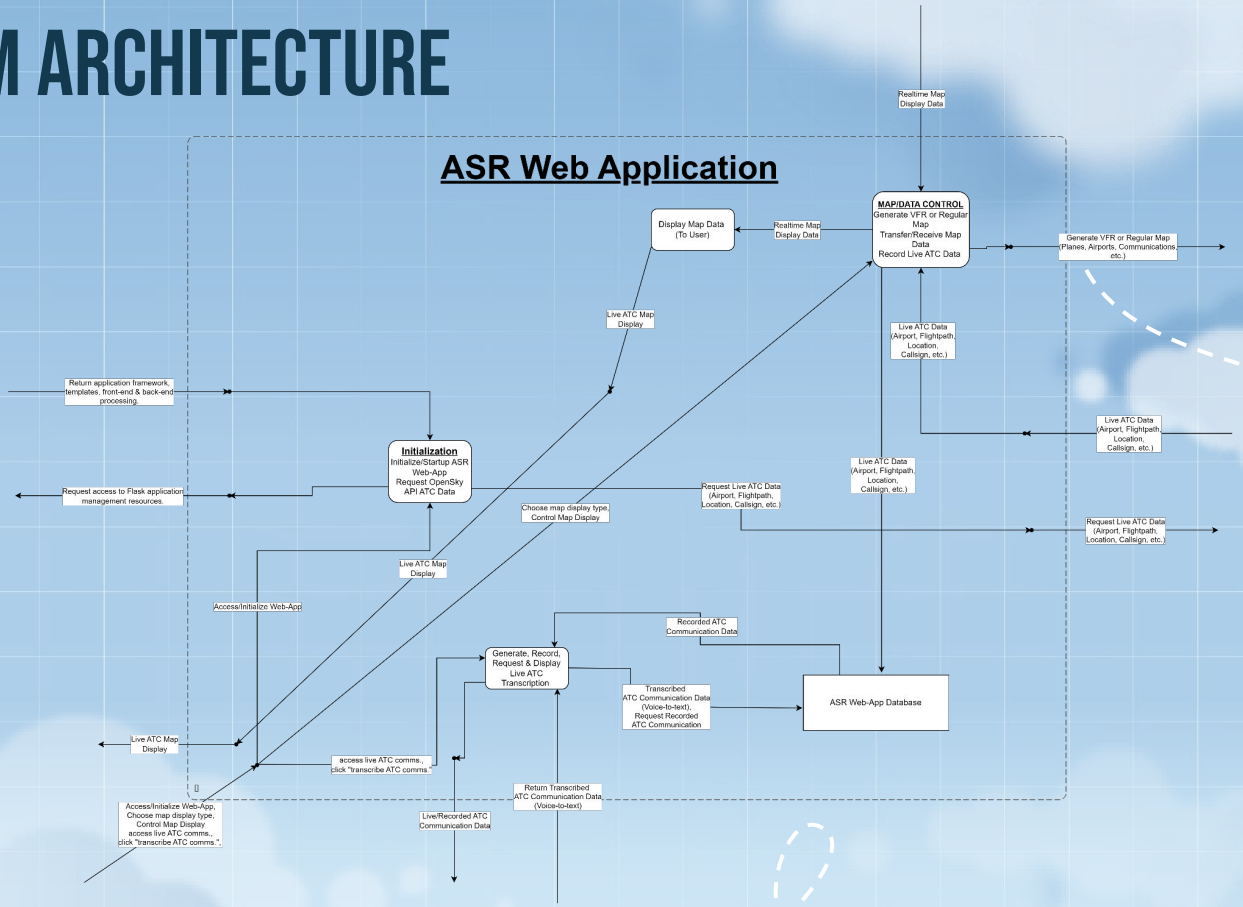
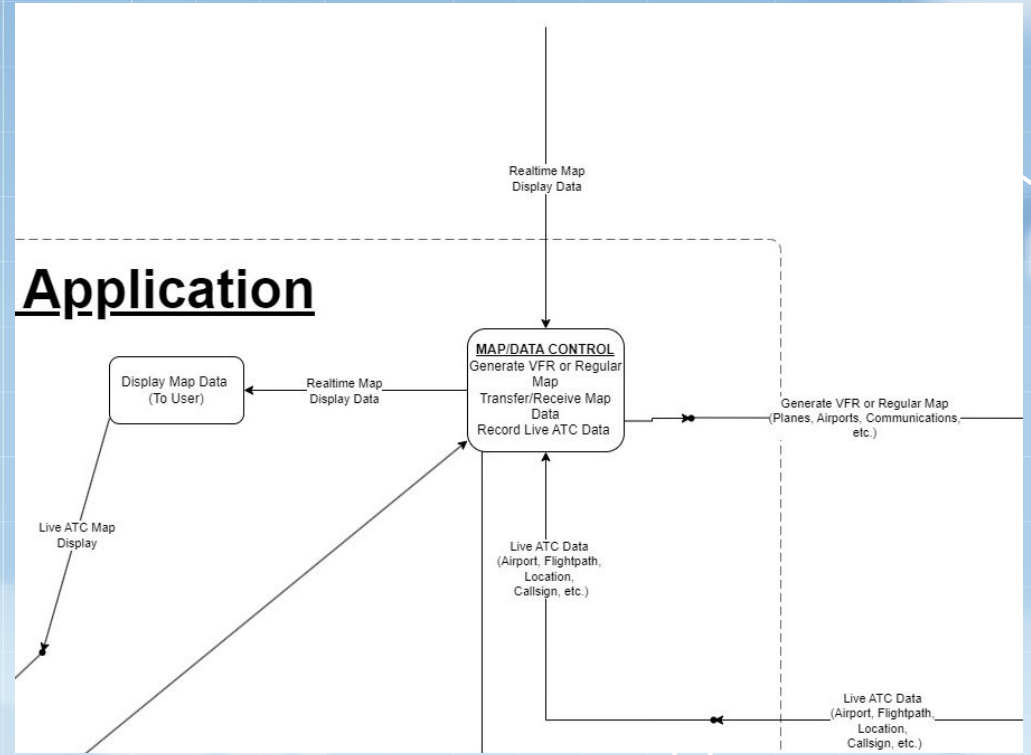
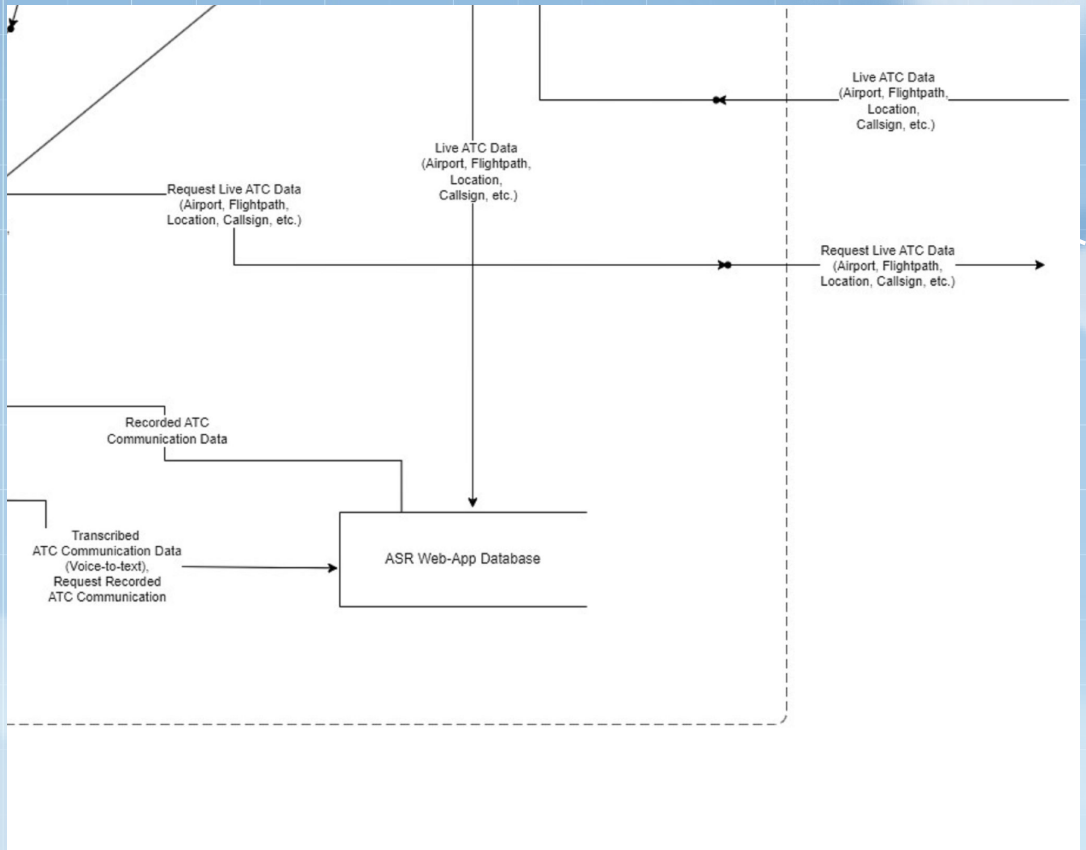


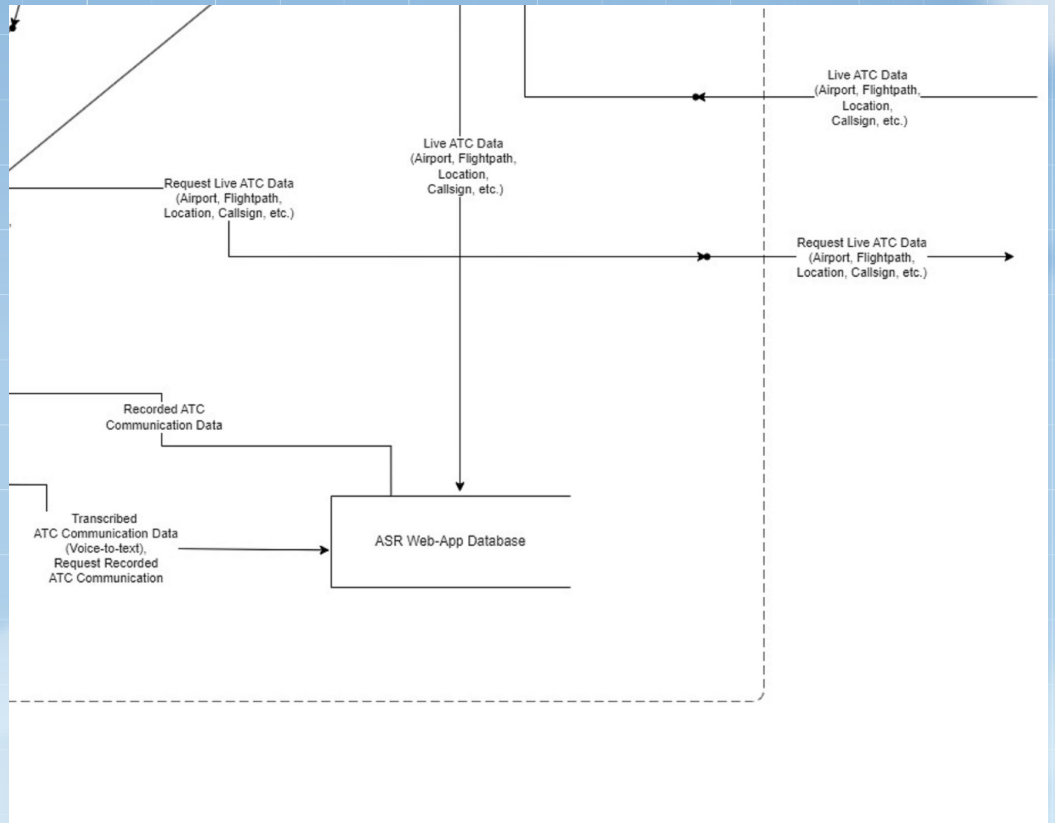
SYSTEM ARCHITECTURE

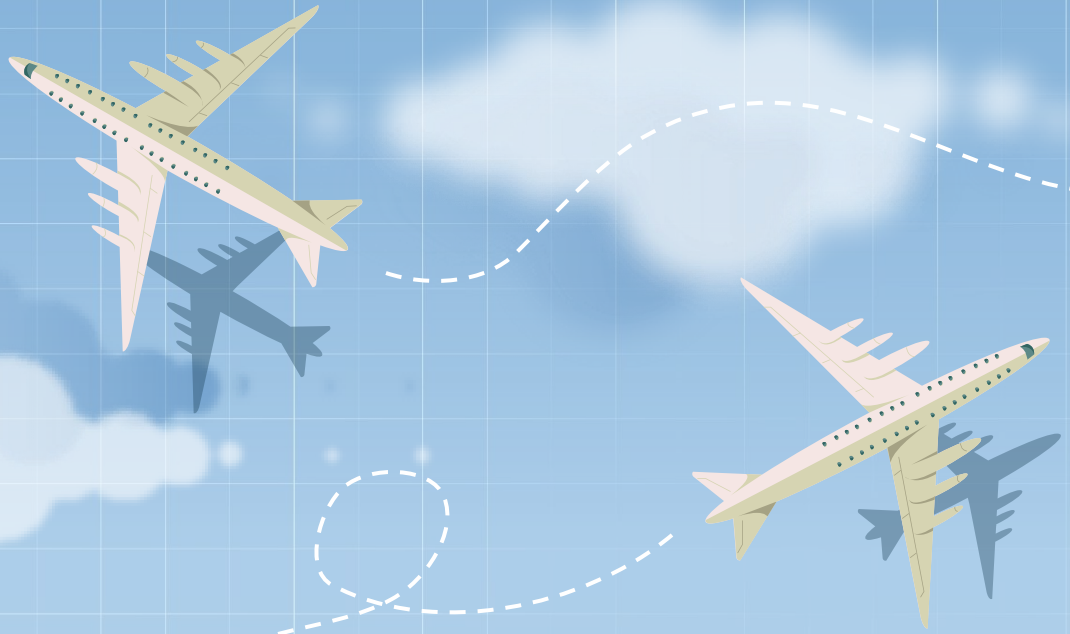


SYSTEM ARCHITECTURE



SYSTEM ARCHITECTURE





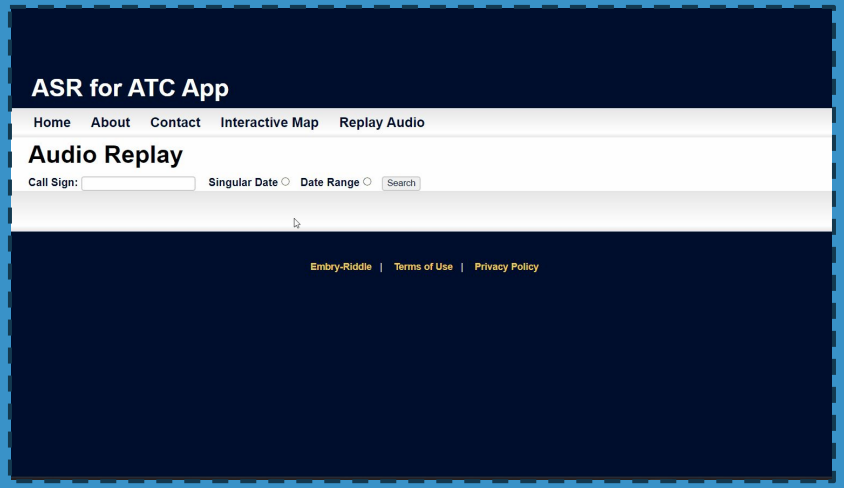
03

FRONTEND

User interface updates

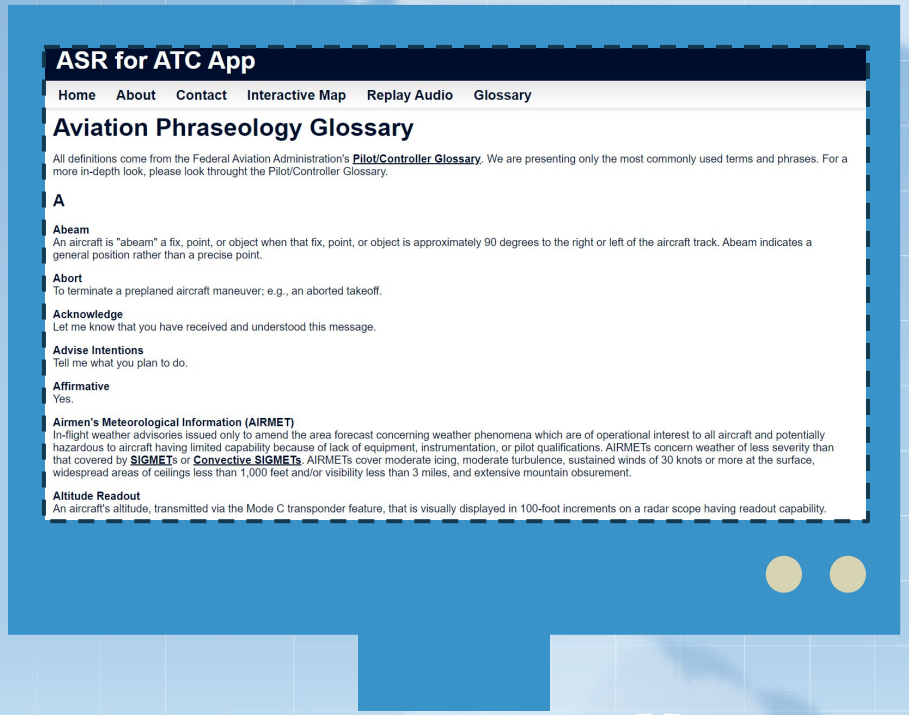
AUDIO REPLAY PAGE

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..



PHRAESEOLOGY 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.

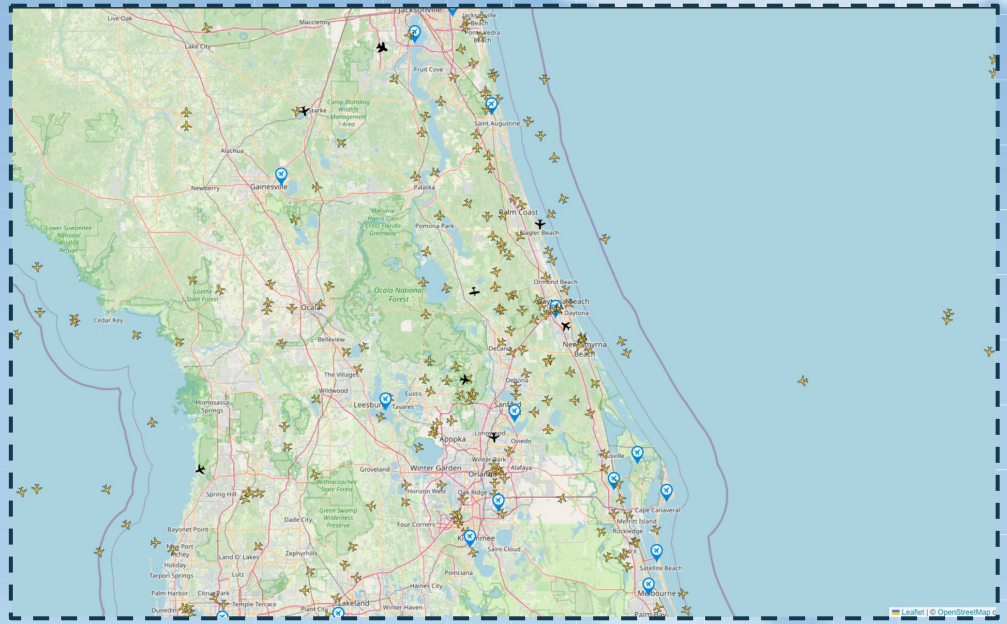
Affirmative
Yes.

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.

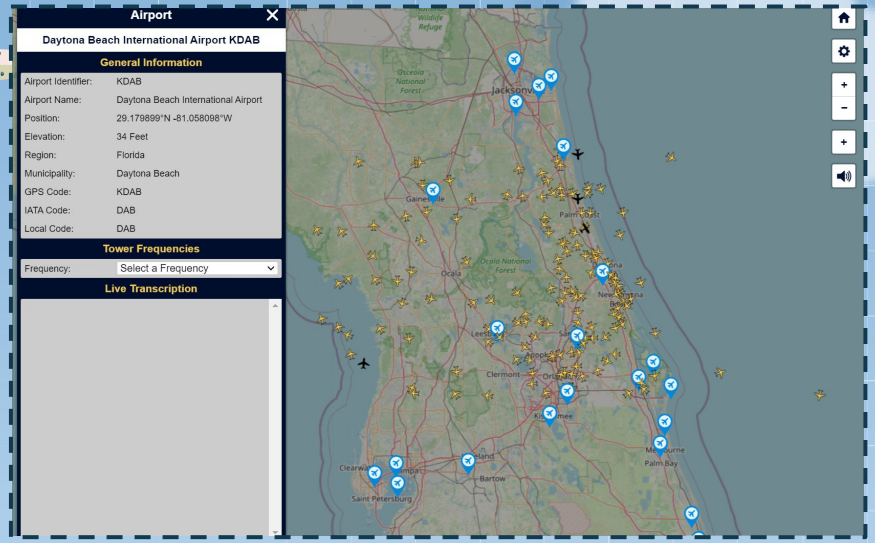
IMPROVED PLANE ICONS

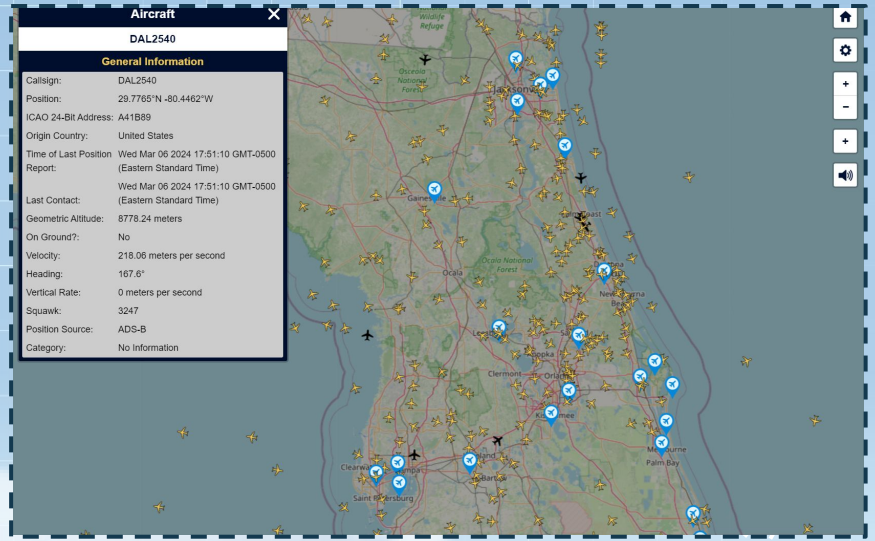
Ongoing facelift of key web application, improved plane icons now with color. Yellow by default, different colors for hover over, selection, and active speaker



STYLIZED PANELS

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

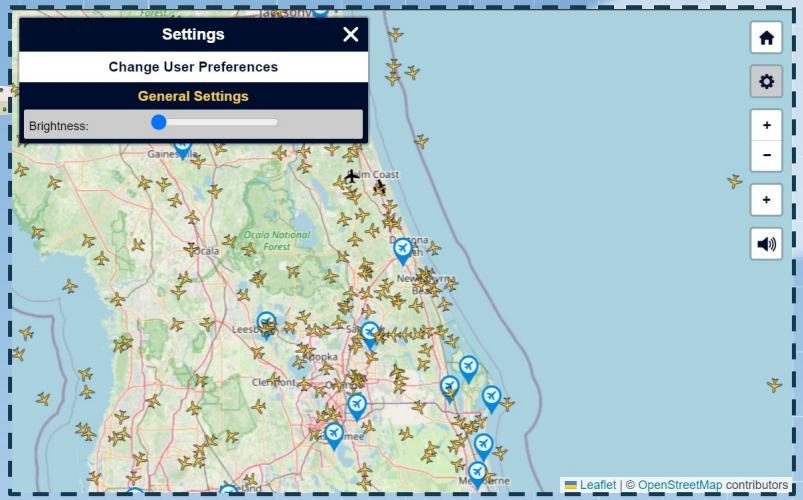


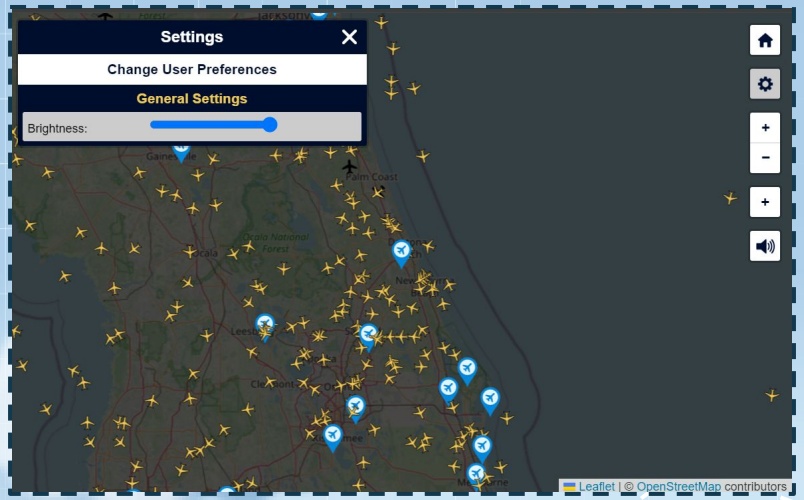


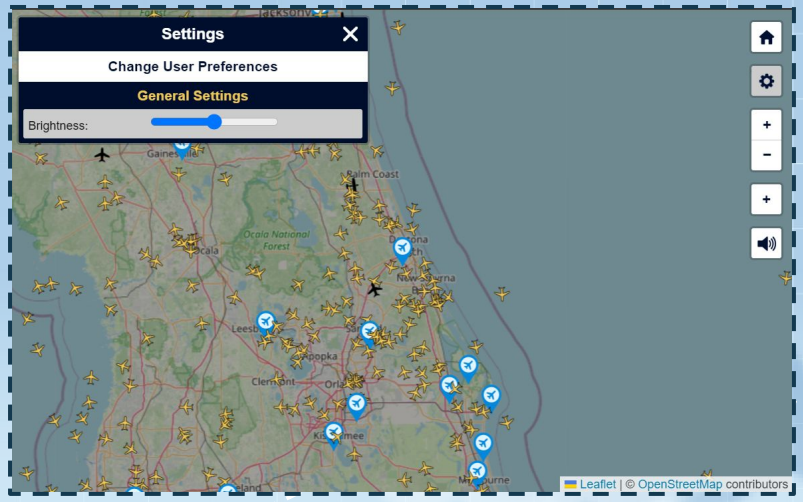
(Top) Airport Information with Tower Frequencies available, (Left) Aircraft Information

BRIGHTNESS

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

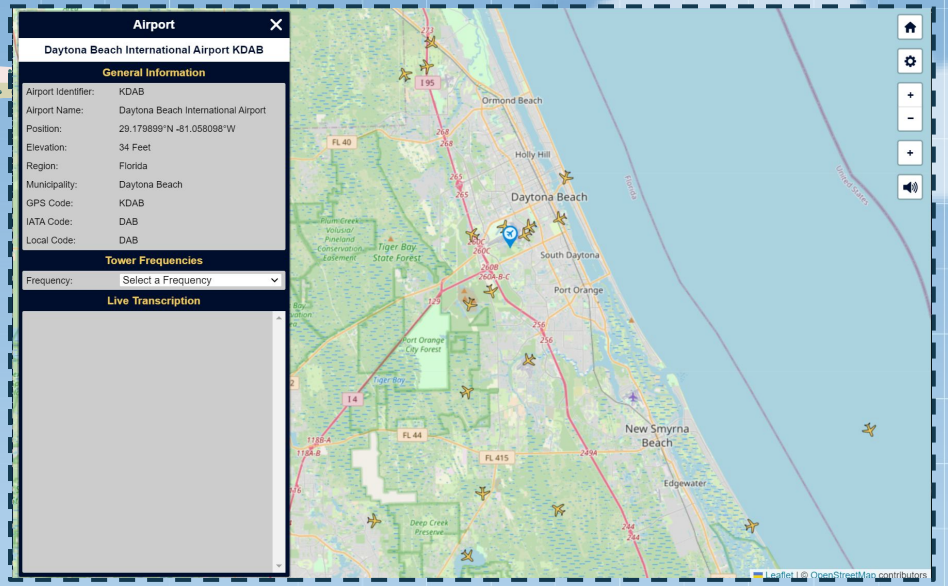


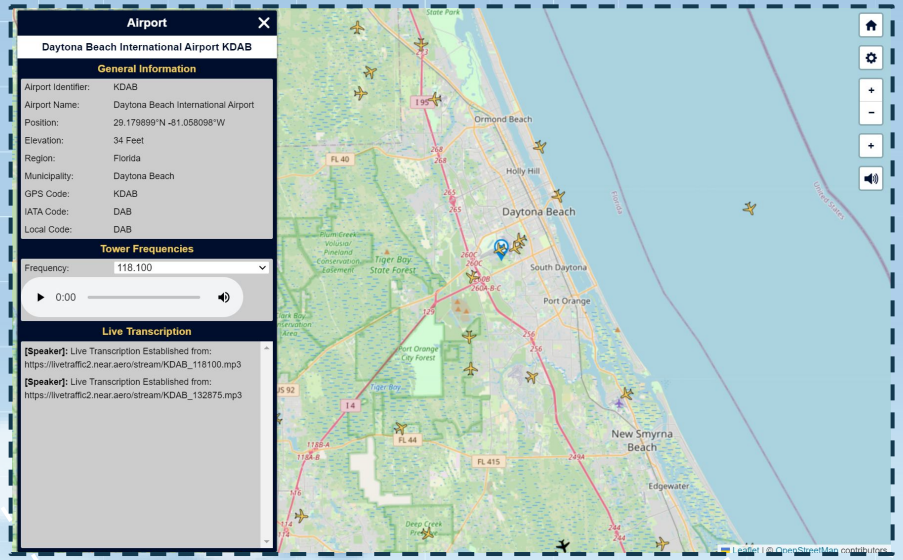




FREQUENCY SELECTION

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

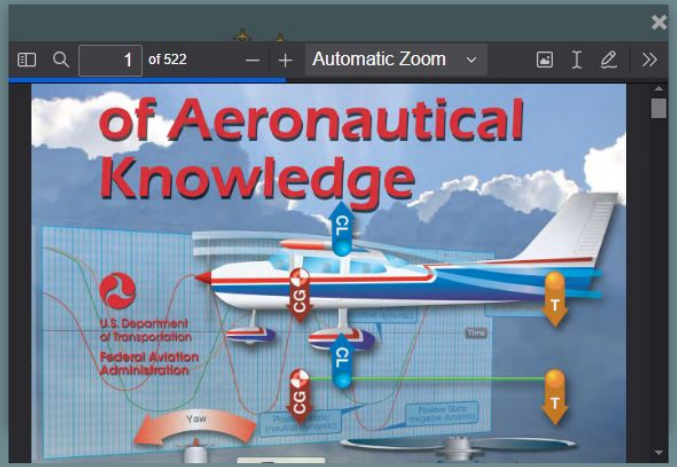




(Top) Frequency not yet selected,
(Left) currently displaying frequency source being used

PILOT'S HANDBOOK

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



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

Sprint 1 Database

- Original database using sqllite connected with SQLAlchemy.
- Realized that it was only able to hold so much 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 SPRINT 2

- 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 -
```

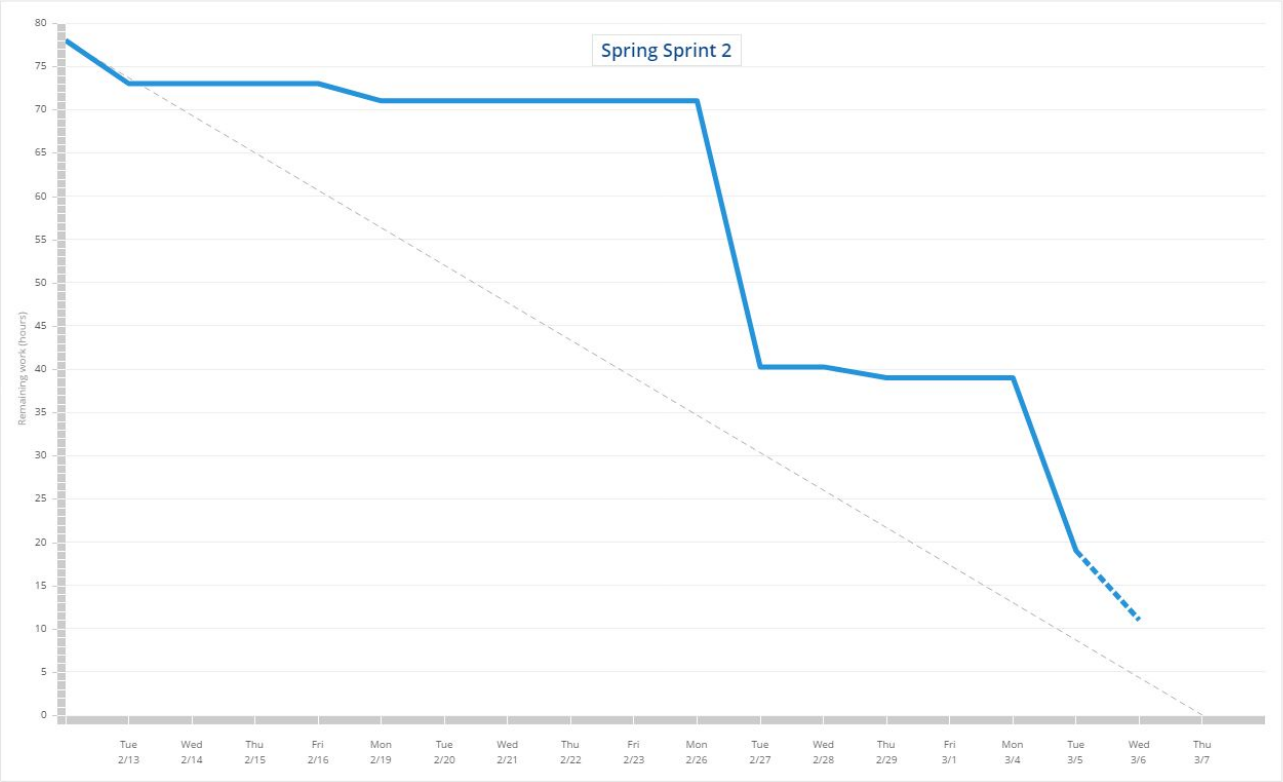
id	icao24	callsign	origin_country	time_position	last_contact	longitude	latitude	geo_altitude	on_ground	velocity	true_track	vertical_rate	squawk
1	a0cfbd	AAL1097	United States	1709573778	1709573779	-81.4326	31.2379	10340.3	0	227.86	10.14	-0.33	1437
2	ad694c	SWA1468	United States	1709573733	1709573747	-81.2219	31.9811	10729	0	229.53	10.98	9.75	6272
3	a73ab6	JIA5057	United States	1709573343	1709573689	-83.394	31.8418	9723.12	0	218.19	31.4	-0.33	NULL
4	a61c53	GTI9128	United States	1709573770	1709573784	-83.0804	28.8748	12847.3	0	261.92	159.54	0	6540
5	a99643	N717CC	United States	1709573791	1709573791	-82.472	28.0944	243.84	0	52.58	120.58	0.98	NULL
6	ab27c7	N818HD	United States	1709573734	1709573734	-82.4778	27.9556	297.18	0	3.13	80.54	-0.98	NULL
7	ac47b7	SWA4259	United States	1709573735	1709573794	-82.4534	28.4388	8633.46	0	190.88	270.93	18.53	NULL
8	a706a8	FFT1690	United States	1709573706	1709573706	-81.0805	28.4763	3322.32	0	167.03	125.6	6.5	NULL
9	a91c44	W74NG	United States	1709573732	1709573732	-80.7266	28.423	3429	0	129.35	335.07	0	NULL
10	a3ecc8	FFT3148	United States	1709573788	1709573788	-82.6864	30.4904	11574.8	0	219.68	0.67	0	3727
11	a69c5e	N525JW	United States	1709573732	1709573732	-80.9601	28.3976	10393.7	0	147.11	340.17	0	NULL
12	a582b7	N454TX	United States	1709573771	1709573771	-82.7388	28.1095	4587.24	0	132.48	351.96	16.91	7465
13	a06310	FDX55	United States	1709573733	1709573733	-82.1989	26.6094	11094.7	0	272.92	150.78	0	NULL
14	a146f9	UAL880	United States	1709573766	1709573766	-80.807	30.9889	10622.3	0	233.77	191.04	0	1261
15	a76a8c	N577XW	United States	1709573794	1709573794	-82.4016	28.8206	6637.02	0	188.21	25.93	6.83	7414
16	a837a5	UAL2000	United States	1709573732	1709573732	-82.964	28.6325	10462.3	0	188.59	291.1	12.03	0732
17	acc76b	AAL1232	United States	1709573794	1709573794	-82.914	29.0821	8823.96	0	204.59	324.31	0	NULL
18	a52e62	AAL2889	United States	1709573733	1709573734	-82.7897	27.865	11643.4	0	275.46	140.3	0	NULL
19	a6b55a	NKS3066	United States	1709573786	1709573786	-83.1023	31.3351	10389.9	0	241.15	154.47	0	NULL
20	a126c6	UAL1562	United States	1709573771	1709573779	-83.8551	28.1395	11658.6	0	240.9	27.33	-0.33	NULL
21	a891e0	EJA651	United States	1709573771	1709573778	-81.2005	28.7507	7688.58	0	190.39	328.93	11.7	NULL
22	a945ed	NKS1615	United States	1709573778	1709573778	-81.4307	29.1138	8153.4	0	199.8	353.64	11.38	NULL
23	a87e7d	NKS3583	United States	1709573732	1709573733	-82.5941	30.6151	10957.6	0	223.67	3.43	0	NULL
24	a5cf3c	UAL2161	United States	1709573732	1709573788	-81.1689	28.9004	11010.9	0	196.25	340.24	0	NULL
25	a44939	UAL1144	United States	1709573737	1709573745	-82.6214	30.8122	10949.9	0	226.36	0.39	6.83	NULL
26	a63207	N499FC	United States	1709573566	1709573566	-81.3221	31.8155	2430.78	0	74.79	187.91	0.33	NULL
27	a19572ed	JBU4329	United States	1709573789	1709573789	-81.2274	26.4384	11079.5	0	231.53	28.1	0	NULL
28	a51334	N426PF	United States	1709573732	1709573732	-82.2285	27.2559	6537.96	0	219.34	158.25	9.43	NULL
29	a6e480	EJA543	United States	1709573792	1709573792	-83.1672	29.2435	12847.3	0	178.23	304.65	0	NULL
30	ad2b43	DAL2299	United States	1709573650	1709573672	-82.6912	32.1	9700.26	0	220.58	318.88	0	NULL
31	a7fa70	FFT2635	United States	1709573734	1709573734	-81.2459	28.5489	1859.28	0	131.8	344.61	14.31	NULL
32	a2c2fb	AAY946	United States	1709573778	1709573778	-82.0276	27.9897	7239	0	203.41	342.94	8.13	NULL
33	acd675	SWA522	United States	1709573674	1709573692	-79.4905	26.1994	7597.14	0	230.79	54.89	10.4	NULL
34	a3d7a7	DAL2996	United States	1709573733	1709573733	-82.7407	30.4416	10523.2	0	255.51	149.51	0	NULL
35	a8c028	JBU729	United States	1709573735	1709573735	-79.9034	27.4415	7566.66	0	195.51	294.07	-5.2	NULL
36	adab38	TAI571	United States	1709573778	1709573778	-83.4177	29.2297	11292.8	0	210.39	215.24	0	NULL
37	aa7c64	JBU2625	United States	1709573734	1709573735	-80.8633	27.4459	8397.24	0	247.89	159.72	-10.4	NULL
38	a31fd2	N300FC	United States	1709573697	1709573729	-82.41	29.925	10340.3	0	198.48	161.1	0	NULL
39	a2bbcc	UAL2615	United States	1709573671	1709573671	-82.5467	27.8342	762	0	98.31	1.8	-5.53	NULL
40	acaa74	NKS3387	United States	1709573732	1709573733	-80.7189	27.7896	11529.1	0	191.51	340.54	4.88	NULL
41	a72f3b	EJA561	United States	1709573766	1709573766	-82.0113	27.3545	4343.4	0	175.16	305.56	-9.45	NULL
42	a2b135	UAL650T	United States	1709573766	1709573771	-82.5578	29.8205	10957.6	0	275.66	130.08	-5.85	NULL
43	a9073a	DAL683	United States	1709573733	1709573733	-82.3846	28.503	10088.9	0	206.79	327.5	0	7453
44	a5cf1b	UAL717	United States	1709573757	1709573757	-82.5434	27.9334	182.88	0	75.64	1.17	-4.23	0155

NEXT SPRINT FOR DATABASE

- Find a way to delete old data or possibly store somewhere else.
- Connect database with specific buttons on webapp.
- Integrate NeMo .wav files with the database.

1812	a7f3ab	NKS1745	United States	1709669654	1709669654	-82.2913	28.6771	10759.4	0	223.58	340.23	0	3613	
1813	a2fe18	N292ND	United States	1709669652	1709669653	-81.8794	29.1113	1059.18	0	65.35	146.56	-3.58	NULL	
1814	a80ce8	EPI533	United States	1709669644	1709669644	-80.9066	28.9661	259.08	0	47.16	63.43	1.3	NULL	
1815	a61bb1	ERU493	United States	1709669654	1709669654	-81.3867	29.4051	1280.16	0	52.87	10.65	0	NULL	
1816	a74ecc	DAL151	United States	1709669654	1709669654	-82.7699	29.7187	11658.6	0	255.03	155.19	0	NULL	
1817	ab201a	ERU816	United States	1709669653	1709669653	-81.0922	29.459	1143	0	53.84	333.92	2.6	NULL	
1818	adb0b4	AAL2941	United States	1709669653	1709669654	-82.6921	29.5407	8542.02	0	229.44	0.26	0	1466	
1819	ac4e08	N892PA	United States	1709669653	1709669653	-81.8295	28.8188	312.42	0	53.11	301.53	0.65	NULL	
1820	ad0c02	JED807	United States	1709669645	1709669650	-81.571	29.6827	1386.84	0	64.43	295.54	0	NULL	
1821	acc9c3	ERU923	United States	1709669653	1709669653	-81.0926	29.3208	281.94	0	55.6	292.29	0.98	NULL	
1822	ab9697	ERU846	United States	1709669654	1709669654	-81.206	29.3084	487.68	0	47.98	265.7	2.6	NULL	
1823	a59a0f	ERU460	United States	1709669654	1709669654	-81.0993	29.2792	571.5	0	42.51	158.71	-0.98	NULL	
1824	a05080	N11934	United States	1709669365	1709669365	-81.2488	28.7699	99.06	0	33.41	80.25	-2.6	NULL	
1825	a43f7d	FFT4602	United States	1709669654	1709669654	-81.3211	29.2763	11026.1	0	223.03	347.34	0	NULL	
1826	ab4799	ERU826	United States	1709669654	1709669654	-81.4592	29.2445	716.28	0	51.28	13.34	0.98	NULL	
1827	a921f1	LFA545	United States	1709669652	1709669654	-81.2228	28.8777	594.36	0	60.17	352.63	-0.33	NULL	
1828	ad1c78	ERU944	United States	1709669653	1709669653	-81.3241	29.2212	312.42	0	55.51	209.42	0.33	NULL	
1829	a752ea	JBU1287	United States	1709669652	1709669652	-79.238	29.4809	8877.3	0	228.16	192.5	0.33	NULL	
1830	ab30fc	N820BH	United States	1709669386	1709669386	-81.2951	29.05	297.18	0	64.96	299.41	-6.83	NULL	
1831	a765e3	LFA327	United States	1709669650	1709669652	-81.2756	28.7595	167.64	0	42.3	355.82	-1.63	NULL	
1832	ab313c	DAL998	United States	1709669654	1709669654	-82.2608	28.766	4244.34	0	158.33	173.84	-7.48	NULL	
1833	a7413a	N567DD	United States	1709669654	1709669654	-81.2035	29.6334	1211.58	0	54.8	32.35	-5.2	NULL	
1834	a5bf2f	LJY47	United States	1709669654	1709669654	-81.2396	29.0732	12877.8	0	194.62	340.22	0	NULL	
1835	a93326	LFA549	United States	1709669653	1709669654	-81.7348	28.6911	388.62	0	52.72	84.4	0.33	NULL	
1836	ac9a7f	N911BD	United States	1709669644	1709669644	-82.0848	28.8679	129.54	0	15.96	69.23	0.33	NULL	
1837	acea6c	LFA684	United States	1709669650	1709669653	-80.9756	28.6294	868.68	0	67.25	283.72	2.28	NULL	
1838	a2f092	ENY3814	United States	1709669654	1709669654	-83.0334	29.2279	10119.4	0	221.87	324.25	-0.33	2341	
1839	a7f2c1	LFA472	United States	1709669653	1709669653	-81.8982	28.7073	571.5	0	56.9	37.28	0	NULL	
1840	a6359d	N5DV	United States	1709669654	1709669654	-81.4337	29.0789	1371.6	0	75.97	185.44	0	NULL	
1841	a264a4	SWA1345	United States	1709669654	1709669654	-82.0019	29.2149	5326.38	0	200.73	151.53	-10.73	NULL	
1842	a6e70c	N544CT	United States	1709669652	1709669652	-81.6369	28.9323	312.42	0	33.95	0	-1.63	NULL	
1843	ac30dc	ERU885	United States	1709669654	1709669654	-81.2335	29.0588	579.12	0	53.85	18.95	0.65	NULL	
1844	a4dfb9	ERU413	United States	1709669653	1709669653	-81.3509	29.2856	632.46	0	55.41	164.93	-3.25	NULL	
1845	a55636	ERU443	United States	1709669653	1709669653	-81.0759	29.2316	259.08	0	46.75	155.97	-1.95	NULL	
1846	a6d91c	LFA319	United States	1709669644	1709669645	-81.2547	28.7784	53.34	0	34.5	87.44	-3.58	NULL	
1847	aafca8	JBU1054	United States	1709669651	1709669651	-78.7697	28.6528	10416.5	0	239.31	11.41	2.93	NULL	
1848	abe94c	ERU867	United States	1709669654	1709669654	-81.161	29.3328	754.38	0	48.55	130.27	0.33	NULL	
1849	aaf183	JBU399	United States	1709669654	1709669654	-80.9085	28.795	3093.72	0	144.1	264.88	-8.45	NULL	
1850	a34b15	FFT2416	United States	1709669654	1709669654	-81.3154	29.1215	8343.9	0	215.61	354.25	6.5	NULL	
1851	aca94f	N915AS	United States	1709669654	1709669654	-82.2538	29.7597	2148.84	0	74.74	193.94	0	0714	
1852	a90ba7	LFA539	United States	1709669652	1709669652	-81.7932	28.8121	190.5	0	37.86	132.8	3.58	NULL	
1853	a925a8	LFA546	United States	1709669654	1709669654	-81.4071	28.7015	571.5	0	60.76	272.43	0.33	NULL	
1854	a2e465		United States	1709669429	1709669429	-81.5819	28.7068	NULL	1	4.89				
329.06		NULL	NULL	0	0									
1855	ac8d58	ERU908	United States	1709669654	1709669654	-81.1237	29.3003	22.86	0	26.64	79.99	-2.28	NULL	
1856	ac8bde	N9072U	United States	1709669653	1709669653	-82.6025	29.1806	2324.1	0	130.18	84.79	-4.88	NULL	
1857	ac910f	ERU909	United States	1709669647	1709669647	-80.8599	28.7772	495.3	0	58.53	347.31	0	NULL	
1858	abe77a	SWA1020	United States	1709669654	1709669654	-82.2744	28.6405	8168.64	0	214.39	324.67	4.88	3240	
1859	a9238a	UAL2345	United States	1709669654	1709669654	-79.615	29.4077	9479.28	0	215.48	215.97	0	NULL	
1860	a32734	ERU302	United States	1709669393	1709669394	-81.0823	29.1707	30.48	0	40.96	64.72	-2.28	NULL	
1861	a7dbc1	N605VV	United States	1709669654	1709669654	-83.0883	29.3764	10751.8	0	224.16	321.71	0.33	7346	
1862	a7f762	NKS722	United States	1709669653	1709669654	-81.3357	29.4688	8275.32	0	230.29	356.93	4.23	NULL	
1863	a12f9b	LFA314	United States	1709669654	1709669654	-81.2082	28.7675	289.56	0	49.28	166.11	3.58	NULL	
1864	ad0e2a	LFA693	United States	1709669651	1709669654	-81.3006	28.7816	243.84	0	44.77	88.68	-1.3	NULL	
1865	a60c79	N48900	United States	1709669643	1709669643	-80.8902	28.691	579.12	0	46.34	337.14	1.3	NULL	
1866	a80fb4	N6186V	United States	1709669654	1709669654	-81.182	29.4638	266.7	0	32.87	50.08	5.53	NULL	
1867	a72c78	AAL1649	United States	1709669653	1709669653	-81.2756	28.7864	4274.82	0	206.12	348.77	9.1	NULL	
1868	a9d626	UAL2156	United States	1709669654	1709669654	-82.6737	29.2785	8862.06	0	220.84	352.91	0	1346	
1869	a91e3a	LFA544	United States	1709669654	1709669654	-81.8588	28.8425	304.8	0	54.97	301.61	0	NULL	
1870	ad7657	N967BY	United States	1709669652	1709669653	-81.2376	28.6056	449.58	0	132.01	50.85	0	NULL	

BURNDOWN


Spring Sprint 2
Remaining work (hours)
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Tue 2/13
Wed 2/14
Thu 2/15
Fri 2/16
Mon 2/19
Tue 2/20
Wed 2/21
Thu 2/22
Fri 2/23
Mon 2/26
Tue 2/27
Wed 2/28
Thu 2/29
Fri 3/1
Mon 3/4
Tue 3/5
Wed 3/6
Thu 3/7

IMPROVEMENTS

PROGRESS UPDATES

- Ensuring workflow is consistently updated when progress is made

SPRINT BREAKDOWN

- Break down items better to ensure all items can be completed

FINAL SPRINT PLANS

MAP UPDATES

Polishing Features of Web Application

DATABASE

Streamline database queries and storage

NEMO

Integrating NVIDIA NeMo to transcribe ATC Audio

ORGANIZATION

Preparing project for future

FUTURE

SUMMER 2024, FALL 2024 - SPRING 2025

MOBILE COMPATIBLE

Compatibility for mobile phones & different screen sizes.

API

Integrating a new API for flight data instead of Opensky.

MORE FEATURES

Features like breadcrumbs (mid-air communications) & callsign alignment unable to be completed without reliable API.

FAR FUTURE

BEYOND 2025

KALDI

Integrating Kaldi into the web application to transcribe ATC audio.

Q&A