INTERACTIVE AIRCRAFT LAYOUT OF PASSENGER ACCOMMODATION TOOL

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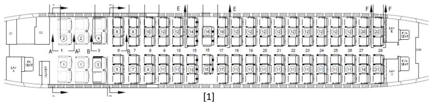
Layout of Passenger Accommodation (LOPA)

- LOPAs are a standard way to represent the layout of the passenger accommodations within the airplane, such as seats and lavatories
- Current process requires use of tables and drawings, and processes are different across Boeing/Airbus fleets
- This tool is an efficient alternative that streamlines the process and allows quicker redesigns of LOPAs
- The tool is a full-stack website, hosted on Azure, that allows users to create, adapt, save, and download LOPAs for any of Alaska's fleets



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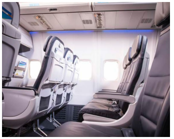
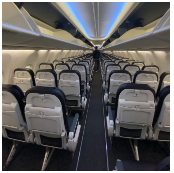
Tool Requirements and Goals

- Minimum requirements:
  - A full-stack web application, stored on Alaska IT's Microsoft Azure platform
  - 737-900ER: display aircraft footprint and integrate part information
  - 2D representation of up and down views of the airplane
  - Accurately display part (dimensions)
  - Different UI for fixed versus variable objects
  - Option to open a pop-up window for any part with its part information
  - Save versions of LOPA in a database
  - Download LOPA visualization and parts included
- Stretch goals:
  - LOPA tool for all of Alaska's fleets
  - 3D representation of up and down views



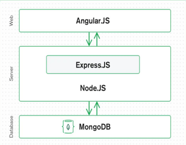


Key Milestones

- Determine the software architecture of the full-stack website
- Develop user-interface for LOPA tool
- Integrate database communication and storage

General Software Architecture

- We are using a MEAN stack software architecture setup
- It is a purely JavaScript/TypeScript stack setup for dynamic website and web application development
- MEAN stands for MongoDB, Express.js, Angular, Node.js
  - MongoDB: NoSQL database with JSON documents
    - Reduces processing required for received JSON files
  - Express.js: web-framework for Node.js
  - Angular: front-end platform and framework
  - Node.js: back-end runtime environment



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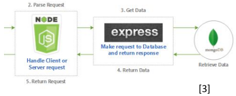
Back-End Software

- The backend for the project consists of two parts: a Node.js Application Programming Interface (API) and a MongoDB database
- Node.js is hosted on Azure App Services and consists of:
  - Express.js, the web server, is used for POST requests from the client and providing logical responses to the client (i.e. login request, project access, etc)



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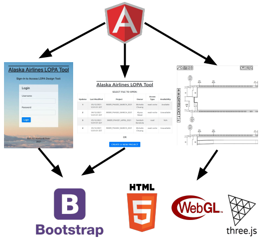
  - MongoDB.js database communication framework does the following tasks:
    - Find, retrieve, remove, and add data to the MongoDB
    - Data includes usernames, passwords, current projects, and associate project data
- MongoDB is hosted on Azure CosmosDB and is organized by collections
  - Each collection is meant for a different data structure type
  - Within collections, each instance of data is stored in a "Document"

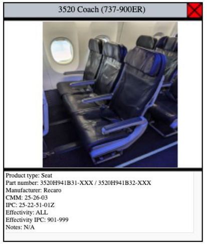
Front-End Software

- Angular is organized by component, with its router module controlling which component to display
- We have five main components: login, create account, files display, create project, graphics
- The login/files pages are created with Bootstrap
  - Bootstrap: CSS/HTML/JS library with design templates to streamline visual element creation
- The graphics page use WebGL and Three.js for the main display visuals and navigation
  - WebGL: JavaScript API for interactive graphics
  - Three.js: JavaScript library to handle WebGL vectorization
- The graphics page's tools and information panels are pure HTML elements
- The user interacts with the application via event listeners, linked to actions such as click and keydown



Final Deliverable

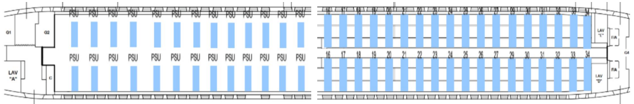
- Back-end:
  - Handles authentication, login verification, new accounts, and project creation/storage
  - Tracks users: their email, password, and projects
  - Stores project information: its owner, locking mutex, list of parts in LOPA with corresponding location
  - Checks file permissions, granting users read-only access or read/write access to individual files
  - When a project is requested by a client, the stored project data is sent to the front-end, where it is processed and the project is displayed
- Front-end:
  - Log in or create a new account to access the tool
  - After logging in, the user is taken to their files, where they can open a previous project or create a new one
  - User-interface tools allow the user to place and manipulate items according to their type
    - Items are either fixed or variable; types are seat, lavatory, galley, closet, or class divider
    - Different interaction modes are toggled via a toolbar
    - Items are automatically labeled/numbered
  - All actions can be undone/redone up to 10 states back
  - Right-clicking on any item opens its corresponding popup, with information about the part and an image of it
  - When a project is saved, the location and type of each object is processed and sent to the database
  - Project can be downloaded, creating a CSV with all parts in the LOPA with their part information and a PDF of the visual layout



3520 Coach (737-900ER)

Product type: Seat
Part number: 3520H941B31-XXX / 3520H941B32-XXX
Manufacturer: Recaro
CMM: 25-26-03
IPC: 25-22-51-01Z
Effectivity: ALL
Effectivity IPC: 901-999
Notes: N/A

Example popup, of 3520 seat



Left half of top view and right half of bottom view from the PDF of the visual layout

Conclusion, Future Work, and References

We successfully created a full-stack web application for an Interactive Aircraft LOPA Tool. We completed all of the requirements, along with some of the stretch goals, producing a fully functional LOPA creation tool.

Future Work:

- Integrate current login system with Alaska's Single Sign-On (SSO)
- Option to view the LOPA in 2D (current implementation) or 3D
- Add Airbus A321 fleet option

[1] Alaska Airlines, "Boeing 737-900ER Aircraft Information," 737-900ER. [Online]
[2] "What is the MEAN Stack? Introduction &amp; Examples," MongoDB. [Online]. Available: https://www.mongodb.com/mean-stack. [Accessed: 24-May-2021].
[3] "How MEAN Stack Work?," IT Outsourcing China, 06-Jun-2019. .

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