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RUNWAY INCURSION PREVENTION SYSTEM (R.I.P.S.)

OVERVIEW

- Introduction
- Background & Research
- Concept of Operation
- Risk Assessment
- Impact
- Conclusion

WHAT IS A RUNWAY INCURSION

FAA definition: any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft.

Types of incursions:

Category A: Serious Incident- accident almost or happened

Category B: Separation is decrease-decreased for Collison

Category C: Ample time/distance to avoid collision

Category D: Runway incursion but no immediate consequences

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TENERIFE AIRPORT DISASTER

- March 27, 1977 in the Canary Islands
- 2 Boeing 747 passenger jets
- KLM Flight 4805 & Pan Am Flight 1736
- 583 deaths, deadliest accident in aviation history
- KLM took off on a foggy runway while Pan Am was taxiing
- Miscommunication between flight crews and ATC

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COMAIR FLIGHT 5191

- Last deadly runway incursion
- August 27, 2006 Blue Grass Airport in Lexington KY
- CRJ-100 carrying 47 passengers and 3 crew members
- Pilot took off on wrong runway

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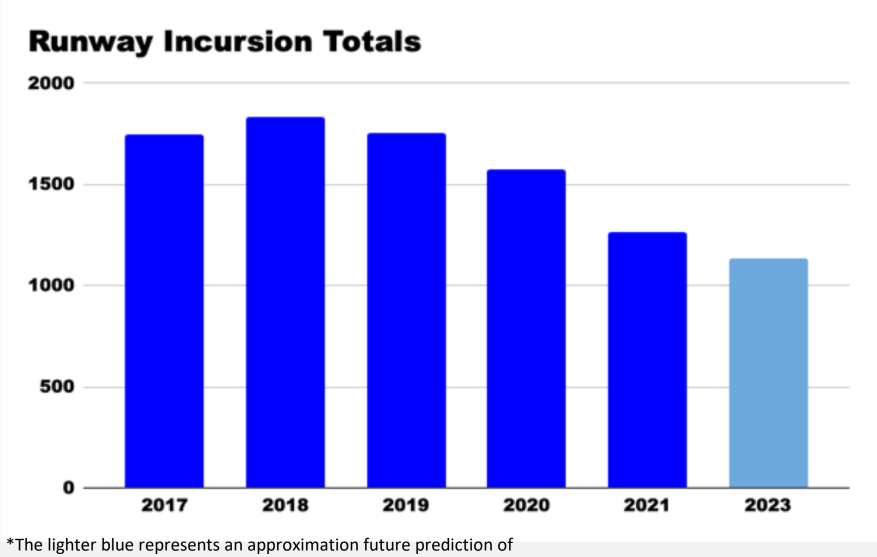
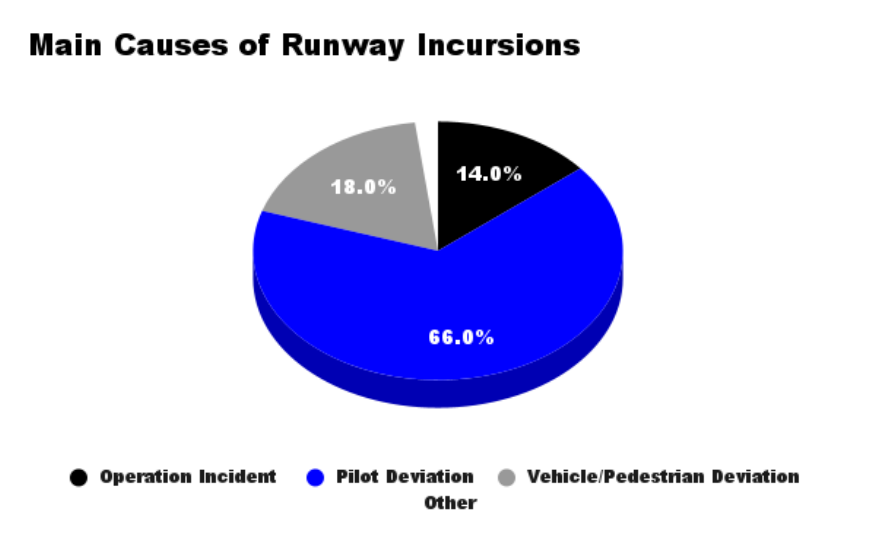


*The lighter blue represents an approximation future prediction of runway incursions if R.I.PS is fully implemented



RUNWAY INCURSIONS BY THE NUMBERS

- Pilot Deviation- 66%
  - The actions of a pilot that result in the violation of a Federal Aviation Regulation
    - Aircraft crossing runway hold short without clearance
    - Taking off or landing on the wrong runway
- Vehicle/ Pedestrian Deviation- 18%
  - Wrong entry or movement on runway by person or vehicle
    - Typically dealing with Airport inspections
- Operation Incidents- 16%
  - Usually dealing with Airport operators
    - Checking for FOD
    - Runway inspections
- Other - 2%
  - Miscellaneous

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RUNWAY INCURSION PREVENTION METHODS CURRENTLY IN PLACE

- Runway Status Lights
- Surface Movement Radar
- GPS monitoring equipment
- ADS-B Separation Technology

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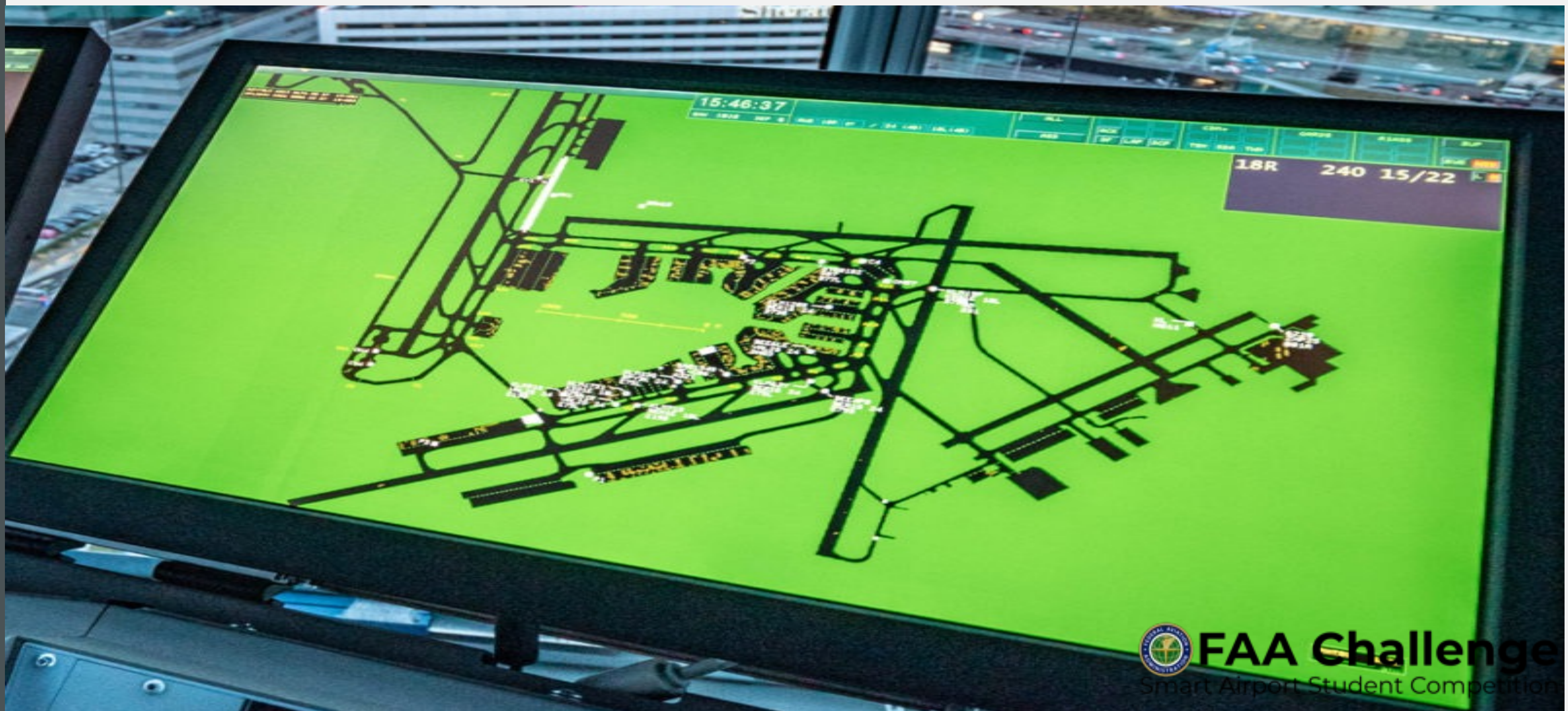


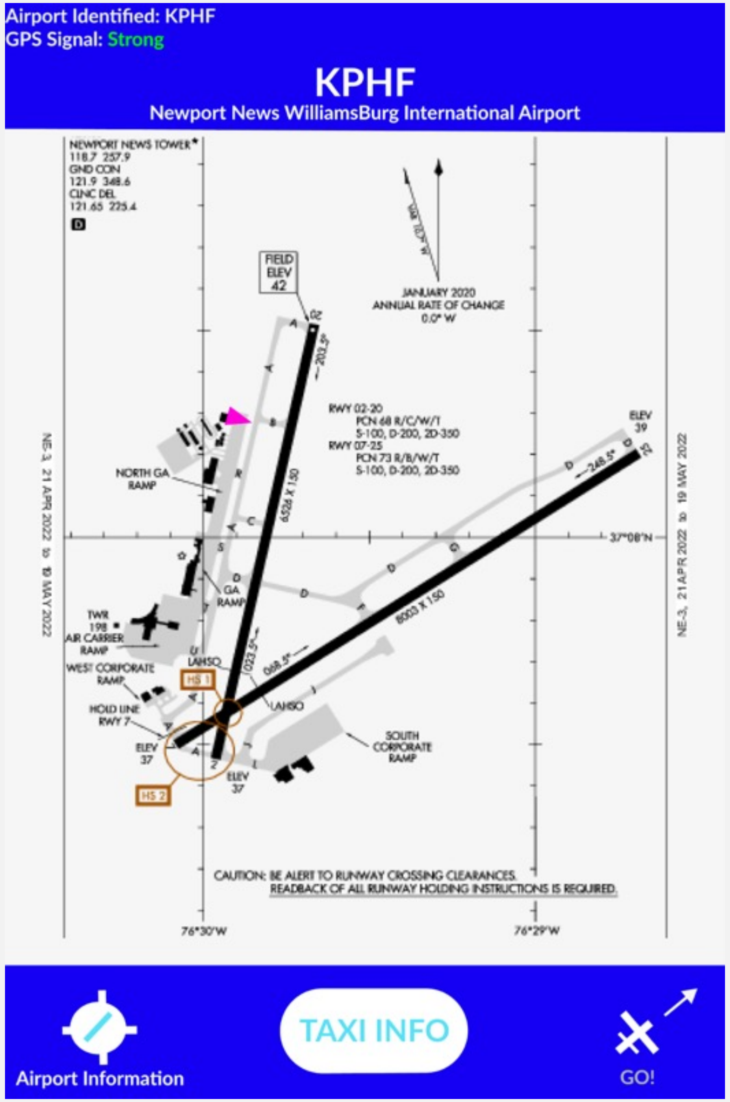
PRESENTING (R.I.P.S)

- R.I.P.S. is an application that utilizes augmented reality (A.R.) to help direct pilots to their respective runways, taxiways, and terminals/ramps. The application will ask for the taxiing route then it will give pilots audible instructions in the cockpit, such as when to make turns, what taxiway they're currently on, and how long they must go before their next turn. This operational guidance would mitigate problems and observe the airport's taxiways and runways. This application will work with and enhance the procedures already implemented in A.T.C. and pilot communication.

APP OPERATION (FRONT END)

- Once the app is opened, the app will use G.P.S. location first to assess where the pilot is and which airport they are in. The app will then set and use waypoints on each taxi to determine what directions will be used.

- The user will be greeted with a few different options. The main option screen consists of two bars. The first bar is a drop down menu of what airport the pilot is at, and the second bar is the destination the pilot will be landing at.



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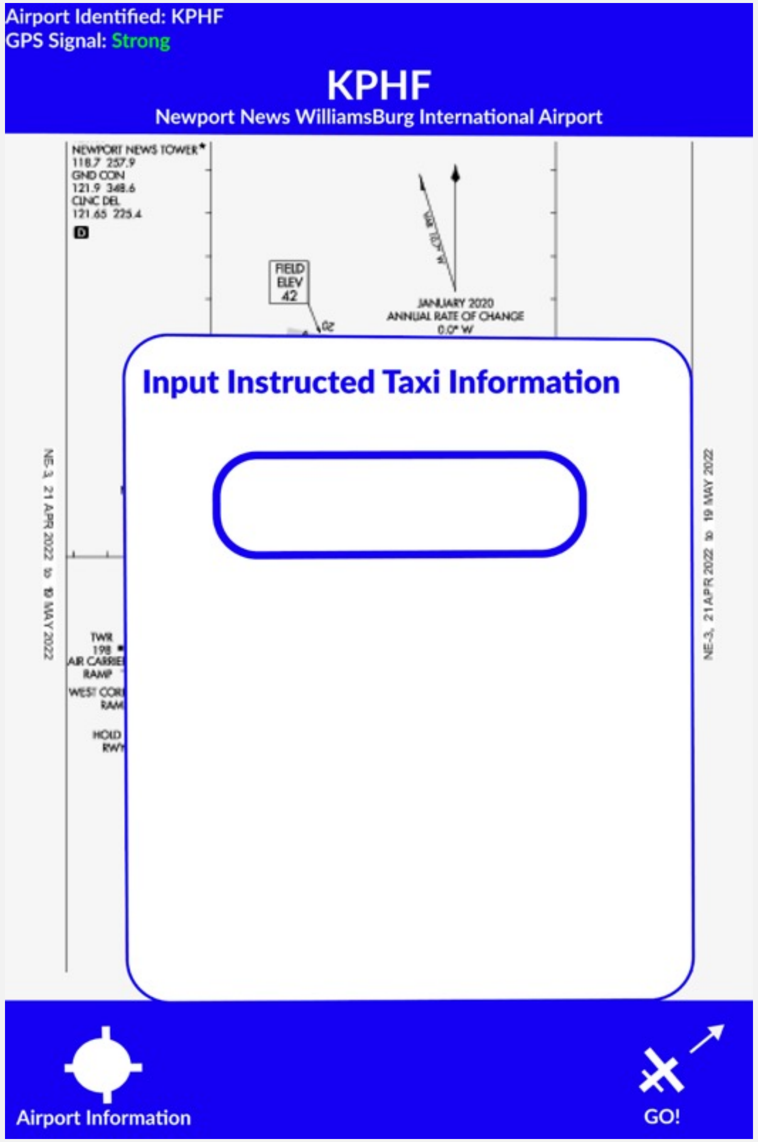
APP OPERATION (FRONT END) CONT

- The pilot will first select the active runway they are departing from. This will then bring up adjacent runways to which the user will be able to quick select taxiway instructions from the controller, or manually input the selection.



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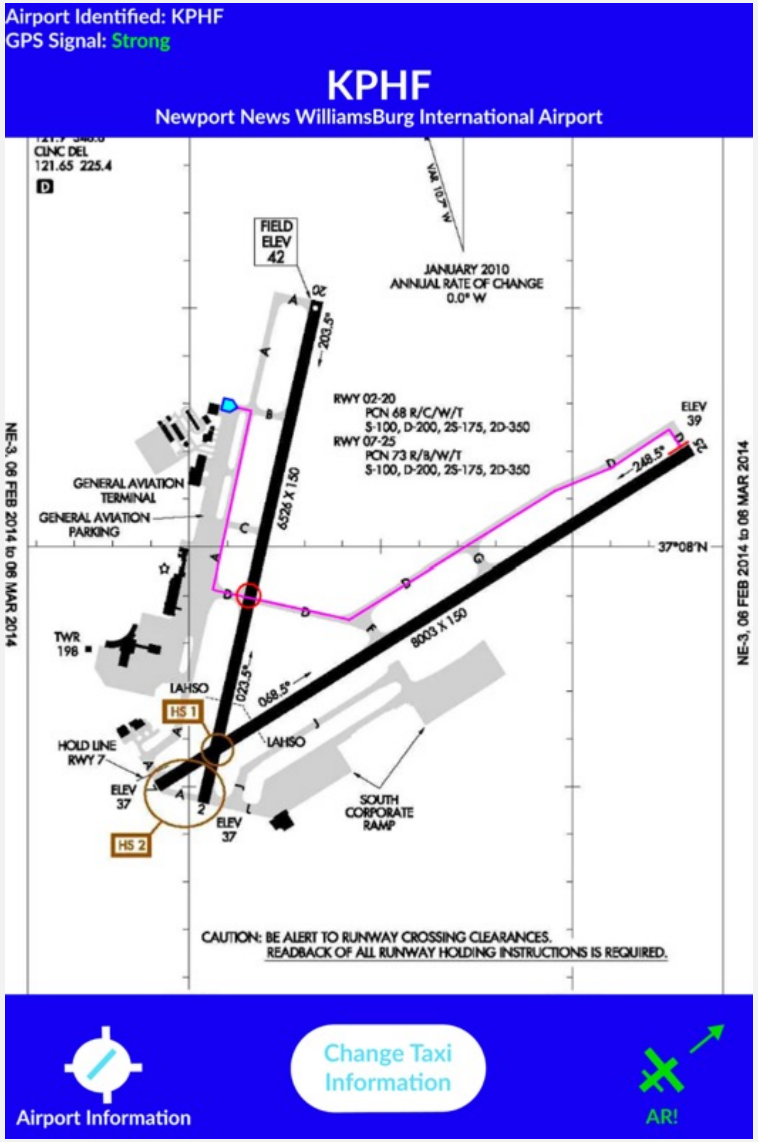
APP OPERATION (FRONT END) CONT.

- Once the selection is complete, this will bring up an overhead view of the airport and the pilot's intended route.

- Once verified, the pilot presses "GO' and is ready for their flight.



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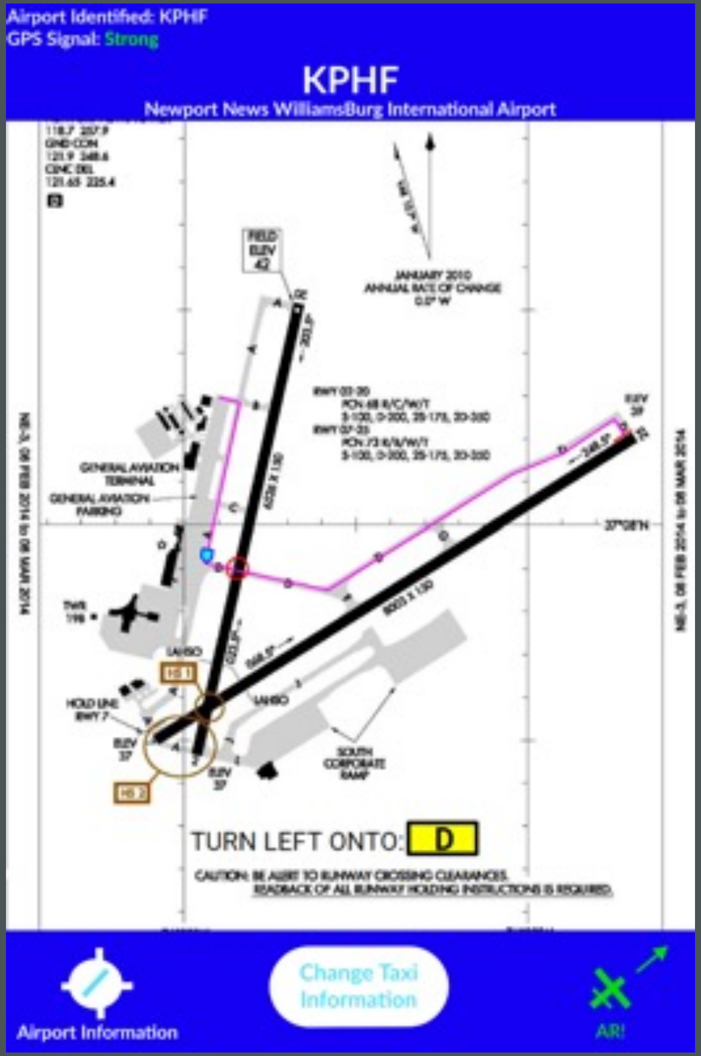
APP OPERATION (FRONT END) CONT.

- The device will then show an augmented reality view of where the pilot is at relative to the ground with directional instructions on when and where to turn.
- The app will also note the different movement areas and alert the pilot of upcoming stops.
- In addition, the app will display the connection reliability in the corner, providing the user with a constant status report of the app.



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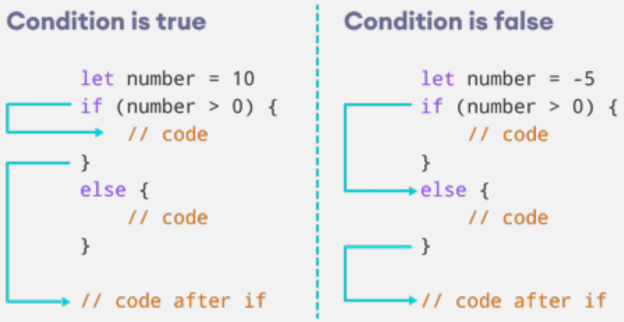
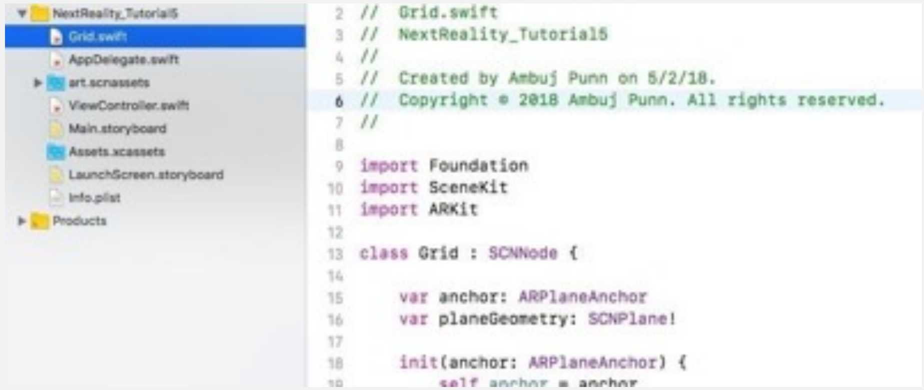
APP OPERATION (BACK END)

- The app will set a waypoint from where the device is to the active runway. The app will either use the the user input taxi instructions or in a non towered environment use a sorting algorithm, such as Dijkstra’s algorithm. This will plot the shortest path and most likely course to the active runway. The app will then pull the taxiways that give the shortest path onto the screen so that the pilot may select them with ease if given taxi instructions. This process will be reversed when the pilot lands the aircraft





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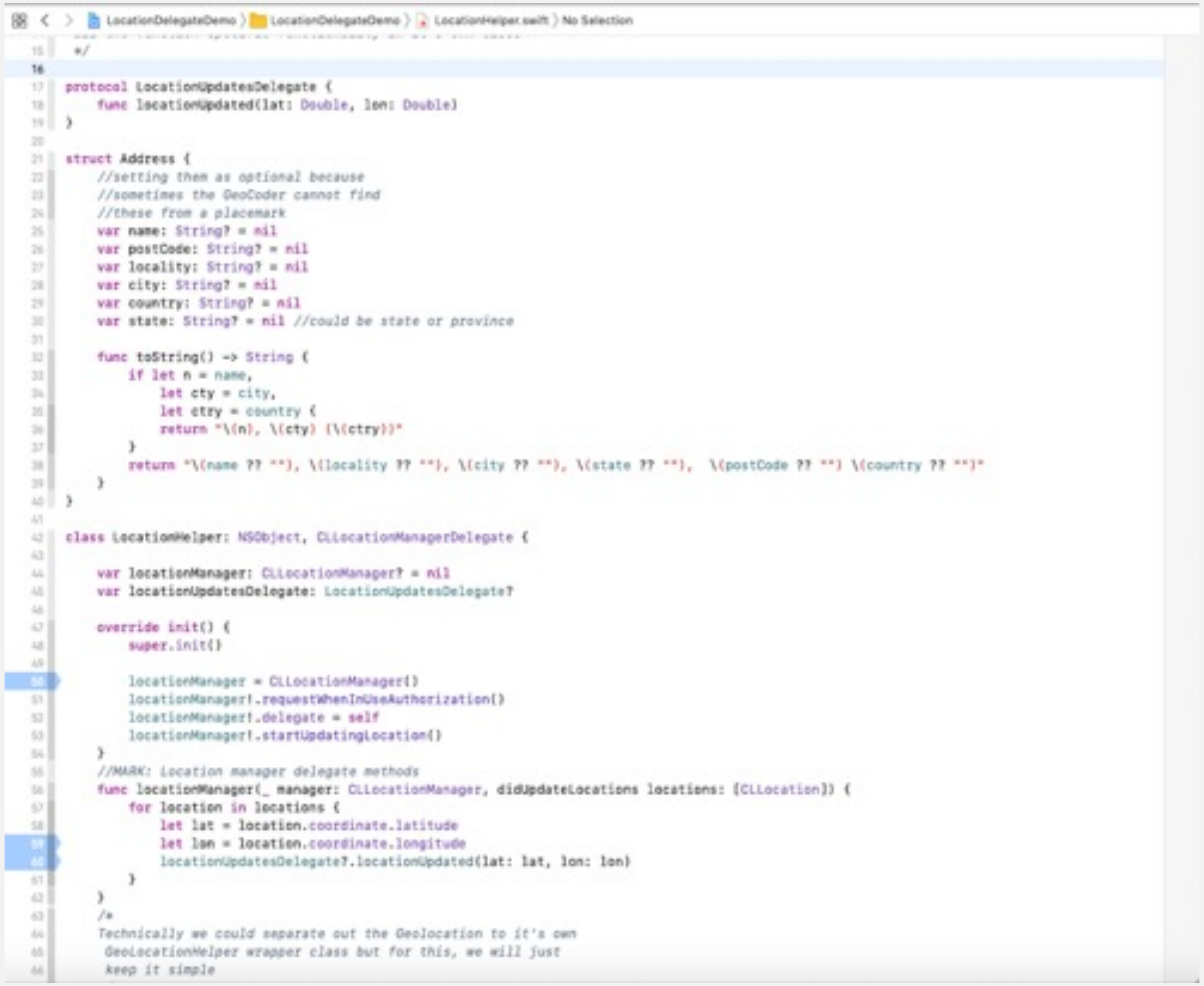
BACK END CONT

- During taxi, the app will use G.P.S. location first to assess where the pilot is. The app will then set and use waypoints on each taxi to determine what directions will be used. Like the basic G.P.S. for car navigation, the app will use the distance formula. the user will receive tips on how far they may be from the end of the taxi, how much longer to go straight, and how much closer they are to turning left or right

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

BACK END CONT.

- Getting the full benefits of the application will require a G.P.S. input that can be provided by the device or external through an ADS-B feed
- Considering the G.P.S. requirement and the possibility of a G.P.S. outage, and intermittent or even incorrect position readings, a non-location-dependent coding string will be written.



BACK END CONT.

- The coding language of choice will be Apple's swift software. It works best with the IOS operating system found on Apple products, which most general aviation Electronic flight Bag (E.F.B.) users prefer. The base code written in the Swift language can also be translated/converted to other coding languages such as C and AVA/SPARK, which are all common languages for avionics found in most general aviation aircraft.

Swift

RISK ASSESSMENT

- Risk mitigation is extremely important in aviation and is possibly what aviation is best known for. Therefore, it is equally important to consider the different risks that may affect our desired goals. Risk mitigation must be looked at and thoroughly thought of. Consequently, the app developing team has created a list of possible risks that could occur with this app. The list also comes along with potential solutions and possible causes of said risks.

Physical risks are those pertaining to physical properties such as aural and visible ques coming from R.I.P.S

Social risks are those involving the user and how they interact with the app, this is significant to improve the intuitiveness and overall usefulness of R.I.P.S

Cyber risks are those pertaining to R.I.P.S application, including any glitches, bugs, errors, or other software problems

RISK EXAMPLES

Physical risks

- Distracted or disoriented users - R.I.P.S will prevent distracted or disoriented users by making it easy for them to follow along by using visual and aural cues as well as AR navigation
- User error while Taxiing - Notify users of upcoming taxiways and ground traffic aurally and/or visually.

Social risks

- Attainability of R.I.P.S - R.I.P.S will be available on both Google's and Apple's respective app store.
- Customization of R.I.P.S - R.I.P.S will be relatively customizable allowing you to change visual and aural cues.

Cyber risks

- Keeping airport diagrams are up to date - Upon choosing a airport, the airport information will be updated onto the device and downloads will be made if necessary.
- Ensuring the correct airport diagram shows upon landing - R.I.P.S will know your location using GPS and choose accordingly.

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SWOT ANALYSIS

STRENGTH	WEAKNESS
•Preventing runway incursions •AR ground navigation •Notification of taxiway traffic •Allows easy familiarization of airport	•Potentially distracting to the pilot. •May not be able to retrieve information while airborne.
Opportunities	**Threats**
•Easy integration into already established applications. •Introduce AR navigation into the GA market.	•Loss of GPS •Incorrect path choice •Overall lack of connectivity

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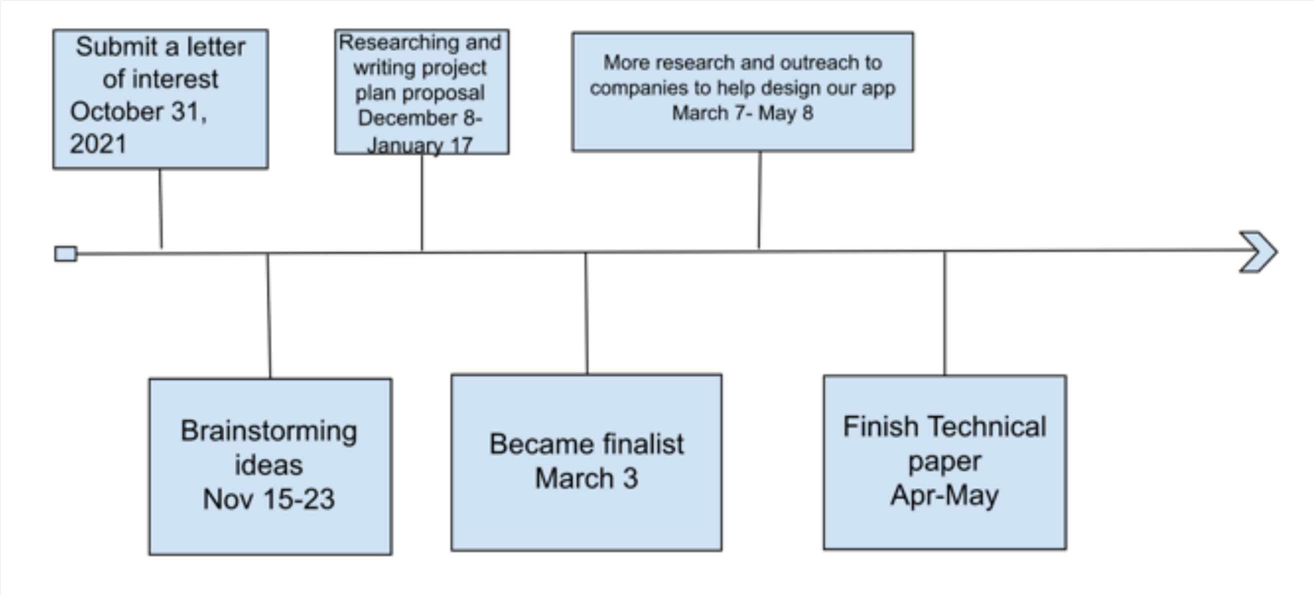
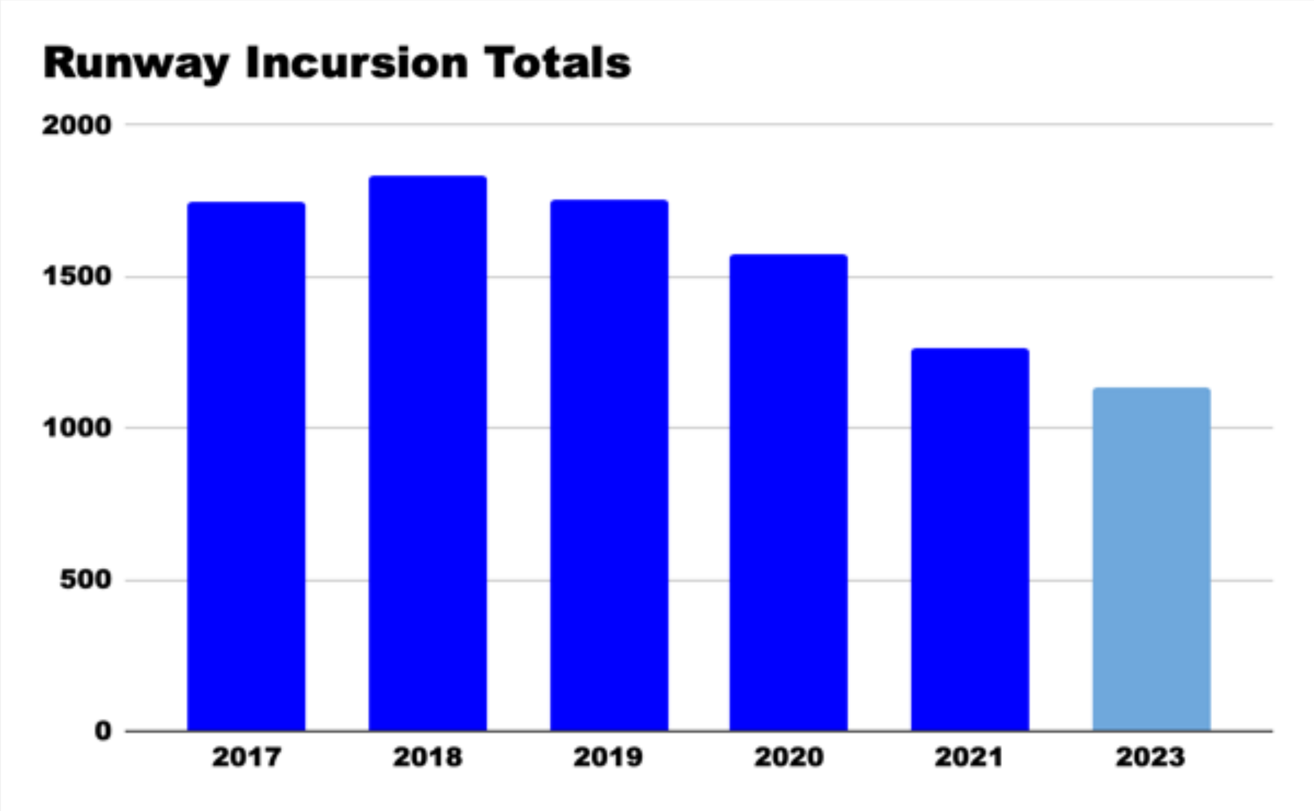
PROJECT TIMELINE



PROJECTED IMPACT

- With how fast pace and complex of an environment some airports have, we plan to help pilots focus on being efficient, safe, and comfortable with our augmented reality-based application.
- Goal to reduce incursions globally, with safety as the first priority
- Application accessible to everyone, from student pilots, to seasoned aviators
- Easy to use, could be used as a tool for learning as well



RELIABILITY AND EFFECT ON USER EXPERIENCE

- R.I.P.S also acts as a great safety net by operating in conjecture with ATC commands and standard operating procedures. It is incredibly reliable, utilizing G.P.S., augmented reality, and onboard transponders that collects data in its surroundings. This way, it covers blind spots, completes lapses, and notifies the pilot if or when there is another aircraft on his/her route. It will act in real-time, and give the pilots a “live look” at what is going on around them.

BUDGET/ESTIMATED COST

- Server Space - $300-50/month
- Research and Development - $27,500
- Privacy Policy - $370
- App Store fee
  - Google Play - 1 time $25 fee for google play store.
  - Apple App Store - 1 time fee of $100/year after that.
- Domain name - $2-7/ month.
- Amazon Web Service - $2000/month

Total:

- $30,302
- $2404/month

CONCLUSION

- With our app in development, we are still waiting to experience its helpfulness and ability in full effect. While waiting for the app to be developed, we have brainstormed some ideas that we believe will also help improve the app and its safety. Some of these features include using ADS-B to see incoming traffic while holding short of a runway, especially at non-towered airports. Another feature we had thought about was a 3D rendering of your taxi route so you can visualize it before departing.

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THANK YOU!

- Questions ?