

MICHIGAN STATE

UNIVERSITY

Project Plan

Tooling Kit Content Verification System

The Capstone Experience

Team United Airlines

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*From Students...
...to Professionals*

Functional Specifications

- United operates 4,600 flights a day.
- Maintains a catalog of 200,000 tools with associated kits for maintenance.
- Needs a fast way to ensure all toolkits are complete when being checked back in.
- Perform an analysis on the image of a toolkit and determine if complete or how many tools are missing.



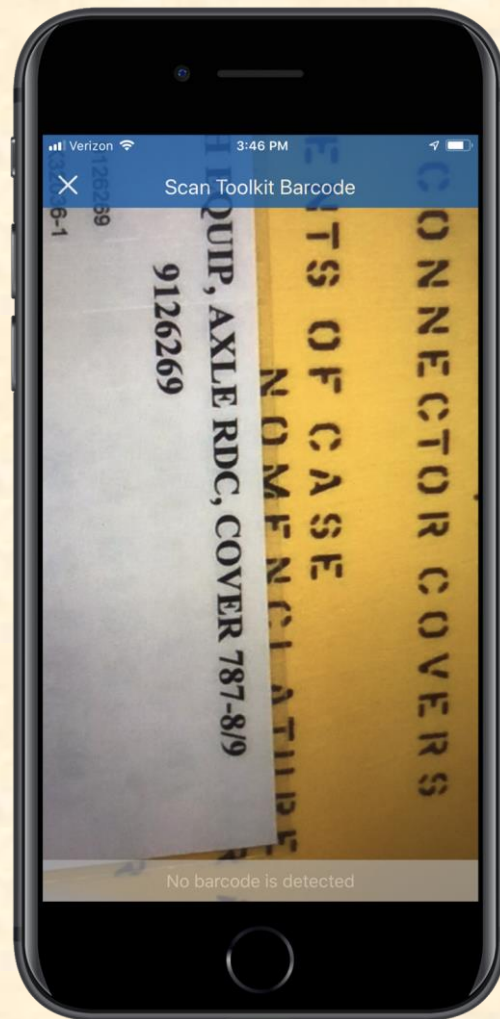
Design Specifications

- iOS app identifies toolkits by the user capturing an image of its barcode on an iPhone/iPad.
- System performs a query of the United database for associated images of the kit contents
- Computer vision is applied to identify items present in kit
- Administrative Web Portal used to provide functionality for adding toolkits to a database.

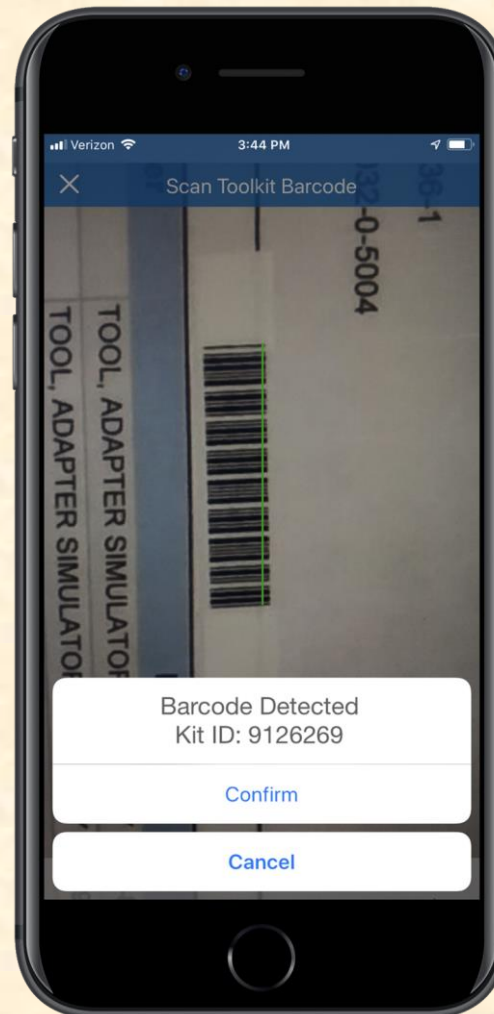
Screen Mockup: Kit Validation Confirmation



Screen Mockup: Initial Barcode Scan Prompt



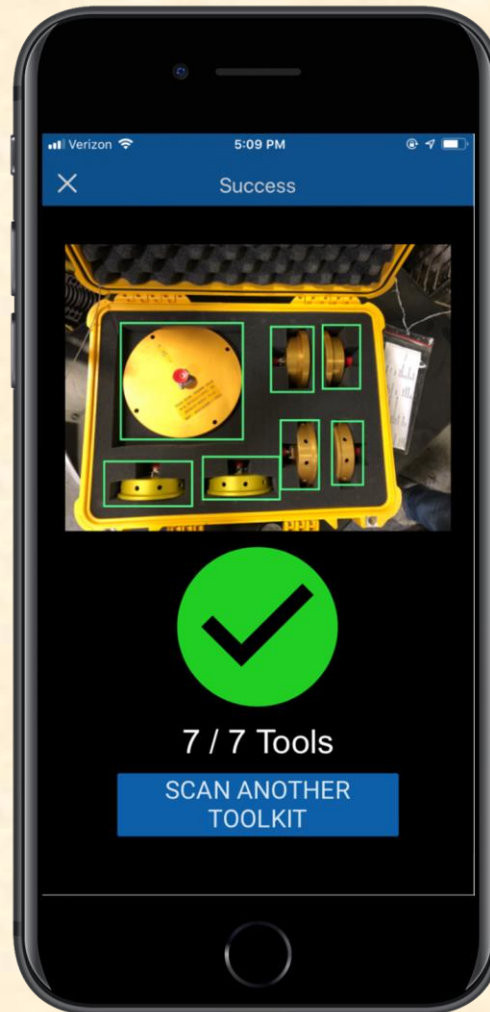
Screen Mockup: Barcode Detected on Kit



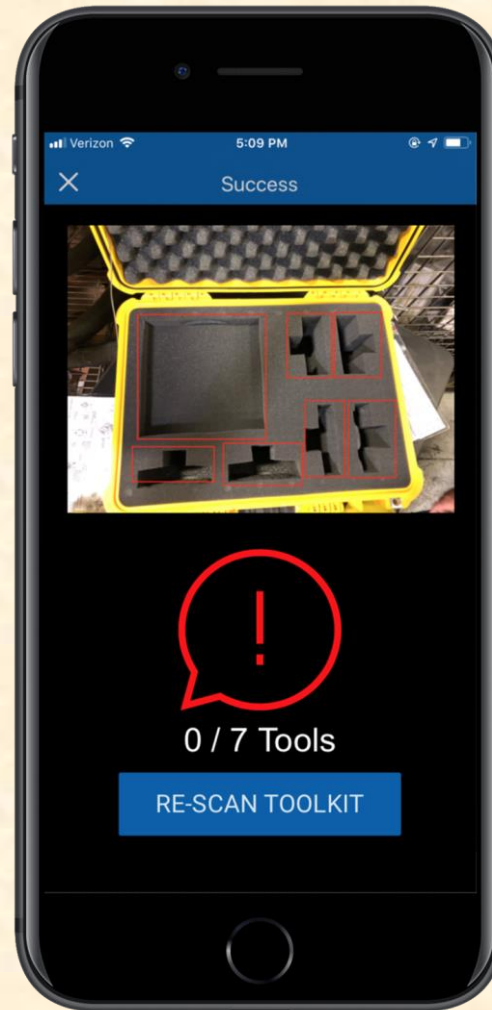
Screen Mockup: Prompt to Scan Toolkit Contents



Screen Mockup: All Tools Found in Kit



Screen Mockup: One or More Tools Missing



Screen Mockup: Web Portal

The screenshot shows a web browser window with the URL "united airlines portal". The page features the United Airlines logo in the top left and a user profile for "Peter G." in the top right. A navigation sidebar on the left contains icons and labels for "Home", "Inventory", "Help", and "Settings". The main content area is titled "Inventory" and displays a table with the following data:

tracking_number	mmsn_number	mmsn_sn	description	mfg_part_number
9101537	99-2034-O-6031	930	KIT, TCAS/XPNDRC/DME/ADS-B, TEL-INST (IMQ)	
9101537	null		TESTER, CABLE ASSY, DIRECT CONNECT	75010186
9101537	null		TESTER, CABLE ASSY, DIRECTIONAL ANT	
9101537	null		TESTER, DIRECTIONAL ANTENNA ASSY	
9101537	null		TESTER, EXTENDER CABLE ASSY, DIRECTIONAL ANT	75010078
9101537	null		TESTER, TEST SET, TR220, SOFTWARE REV. 5.30	90000088
9101537	null		TOOL, CABLE ASSY, POWER CORD	75010025
9101537	null		TOOL, HANDLE ASSY, DIRECTIONAL ANT	88001002
9101538	99-2034-O-6031	931	KIT, TCAS/XPNDRC/DME/ADS-B, TEL-INST (IMQ)	
9101538	null		TESTER, CABLE ASSY, DIRECT CONNECT	75010186
9101538	null		TESTER, CABLE ASSY, DIRECTIONAL ANT	
9101538	null		TESTER, DIRECTIONAL ANTENNA ASSY	
9101538	null		TESTER, EXTENDER CABLE ASSY, DIRECTIONAL ANT	75010078
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9101539	null		TESTER, CABLE ASSY, DIRECT CONNECT	75010186
9101539	null		TESTER, CABLE ASSY, DIRECTIONAL ANT	
9101539	null		TESTER, DIRECTIONAL ANTENNA ASSY	
9101539	null		TESTER, EXTENDER CABLE ASSY, DIRECTIONAL ANT	75010078

At the bottom right of the inventory table, there are two buttons: "+ Add a tool" and "+ Add a kit".

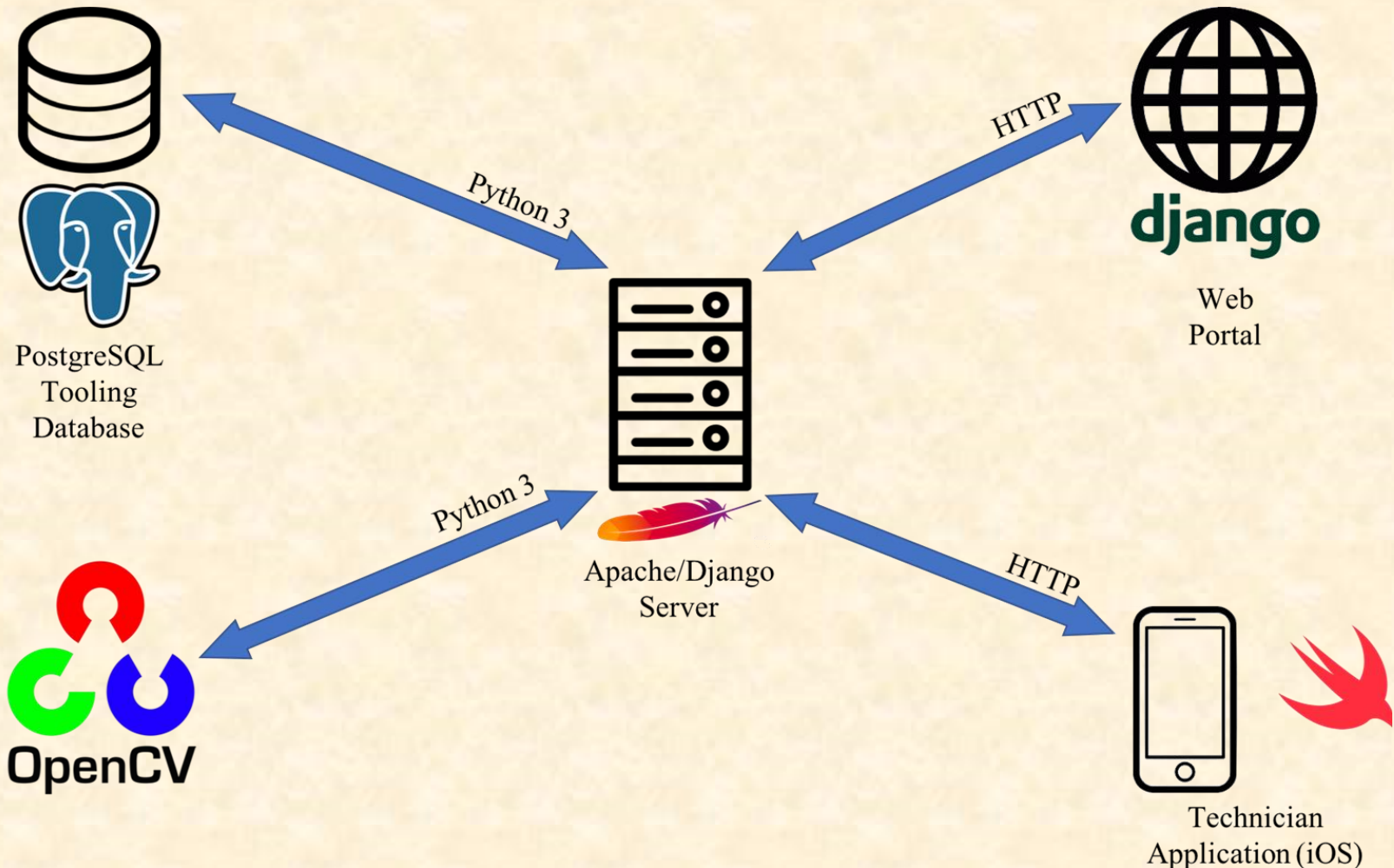


Technical Specifications

- iOS application written in Swift 4.2
- PostgreSQL 10.5 used to simulate United database
- Django (Python) web framework to handle calls from from the iOS app/Web portal to PostgreSQL and OpenCV.



System Architecture



System Components

- Hardware Platforms
 - Ubuntu Server
 - iPhone / iPad
 - Capstone iMacs for iOS development
- Software Platforms / Technologies
 - OpenCV
 - Xcode 10 with Swift 4.2
 - Django Web Framework
 - PostgreSQL Server 10.5



Risks

- Image Analysis

- No team members have prior experience with image analysis despite it being a key functionality of the system.
- Mitigation
 - The OpenCV library is being used to perform the image analysis. The team will work iteratively and utilize information from online resources and documentation to best design the image analysis code.



Risks

- Physical Toolkit Access
 - The team only has access to images of toolkits as provided by United. Each toolkit will vary in style and appearance.
 - Mitigation
 - The CV processing will not be based on a single kit style or layout, but will be designed and tested against each of the samples received throughout the semester.



Risks

- Database Access

- The team does not have direct access to the United database which holds images of the toolkits and a full schema related to the images of each tool is unknown as of yet.
- Mitigation
 - Work with exports of selections of the United toolkit database (sans image data) provided by United contact and set up a PostgreSQL server to simulate the known portion of the schema.



Risks

- Small Tools

- The team's United contact indicated that some tools may be too small to easily identify as present. The application requires a backup for identifying these.

- Mitigation:

- The application allows technicians to override an alert that says that some parts are missing from a kit if the technician can see they are all present. After larger tools are able to be identified using computer vision, the team will work to tune the computer vision to attempt to identify smaller tools as well.



Questions?

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