

MICHIGAN STATE

UNIVERSITY

Project Plan Presentation
Data-Driven Mechanic: Applications and
Infrastructure
The Capstone Experience

Team Michigan State University CSE

Erik Ralston
Kaela Burger
Abhinav Thirupathi
Andrew Brua
Jianyu Deng

Department of Computer Science and Engineering
Michigan State University

Spring 2022



From Students...
...to Professionals

Functional Specifications

- 290 million cars operate below optimal efficiency due to delayed maintenance
- Maintenance can be difficult due to cost and accessibility
- By analyzing sound cues to detect current and upcoming failures, car owners can better anticipate needed maintenance
- This theory can be expanded to analyze failures in a range of devices

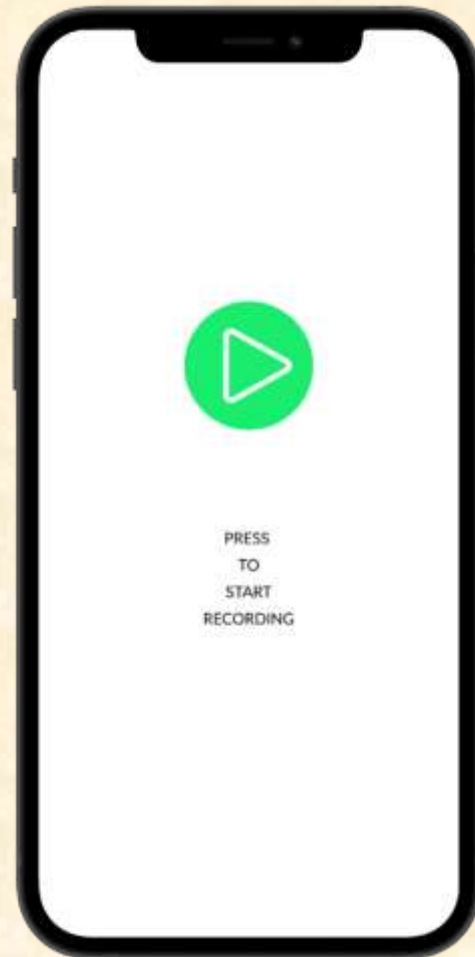


Design Specifications

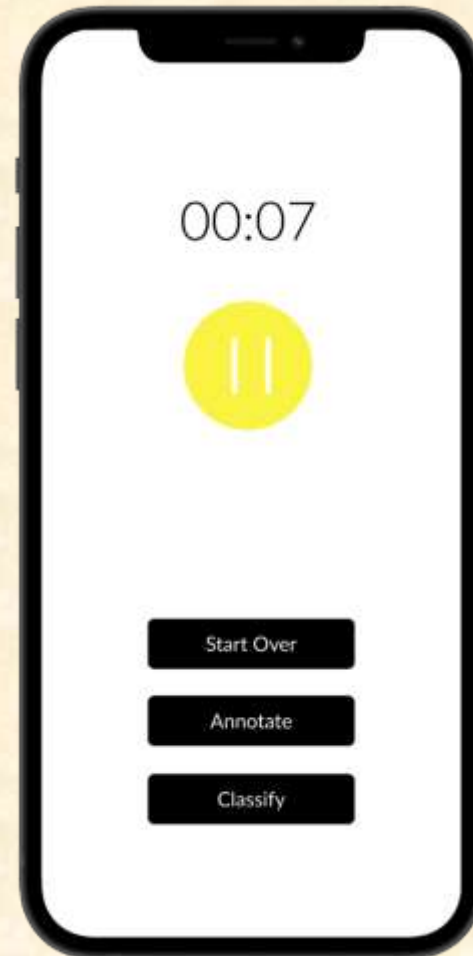
- Minimalist design philosophy was used in the design of our iOS and Android applications
- Simple, easy-to-use UI to focus user's attention on functionality
- Annotation of the collected audio and accelerometer data for future model training
- Classification is the other feature to enable the user to use the previously trained models



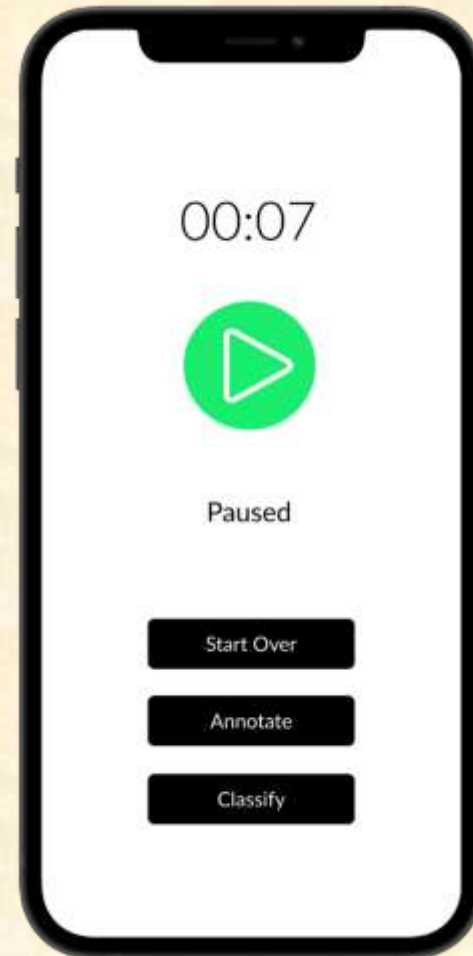
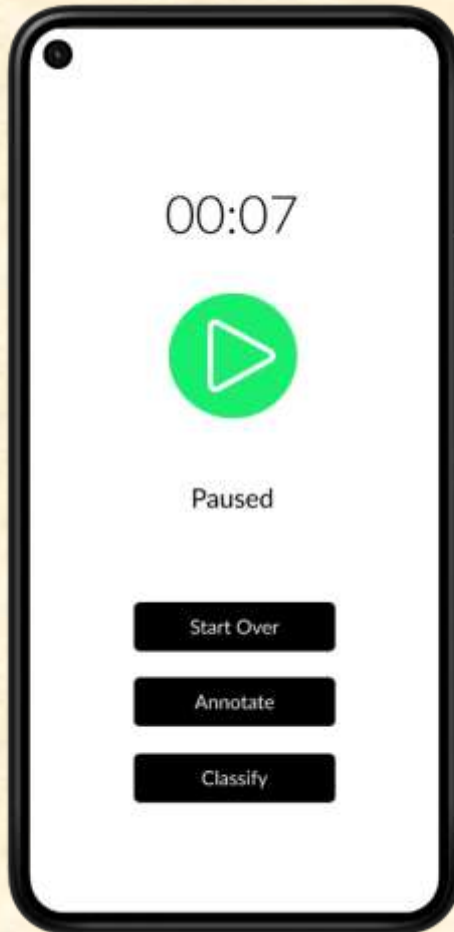
Screen Mockup: Home Screen



Screen Mockup: Recording Screen



Screen Mockup: Paused Screen



Screen Mockup: Annotate Screen

ANNOTATE

ASSET CLASS
Transportation

ASSET SUBCLASS
Passenger Vehicle

SUBCLASS METADATA
Done

STATE DATA
Done

NOTES
The vehicle was involved in an accident

Submit

This mockup shows a mobile application screen titled "ANNOTATE". It features a top-left corner icon. The screen is divided into several sections, each with a label and a corresponding input field or button: "ASSET CLASS" with a "Transportation" button, "ASSET SUBCLASS" with a "Passenger Vehicle" button, "SUBCLASS METADATA" with a "Done" button, "STATE DATA" with a "Done" button, "NOTES" with a text box containing "The vehicle was involved in an accident", and a "Submit" button at the bottom.

ANNOTATE

ASSET CLASS
Transportation

ASSET SUBCLASS
Passenger Vehicle

SUBCLASS METADATA
Done

STATE DATA
Done

NOTES
The vehicle was involved in an accident

Submit

This mockup shows a mobile application screen titled "ANNOTATE". It features the same layout as the first mockup, including sections for "ASSET CLASS", "ASSET SUBCLASS", "SUBCLASS METADATA", "STATE DATA", "NOTES", and a "Submit" button. However, it does not have the top-left corner icon.



Screen Mockup: Annotate Subclass Metadata Screen

ANNOTATE
SUBCLASS METADATA

MAKE
Ford

MODEL
Mustang

YEAR
1966

VIN
138176Z149695

Done

This is a mobile app screen mockup for 'ANNOTATE SUBCLASS METADATA'. It features a white background with a black border. At the top, the title 'ANNOTATE' is in a large font, with 'SUBCLASS METADATA' below it. There are four input fields, each with a label above it: 'MAKE' (containing 'Ford'), 'MODEL' (containing 'Mustang'), 'YEAR' (containing '1966'), and 'VIN' (containing '138176Z149695'). A 'Done' button is located at the bottom center.

ANNOTATE
SUBCLASS METADATA

MAKE
Ford

MODEL
Mustang

YEAR
1966

VIN
138176Z149695

Done

This is a mobile app screen mockup for 'ANNOTATE SUBCLASS METADATA', identical to the one on the left but with pre-filled data. The input fields contain 'Ford', 'Mustang', '1966', and '138176Z149695'. A 'Done' button is located at the bottom center.



Screen Mockup: Annotate Screen

ANNOTATE

ASSET CLASS
Transportation

ASSET SUBCLASS
Passenger Vehicle

SUBCLASS METADATA
Done

STATE DATA
Done

NOTES
The vehicle was involved in an accident

Submit

ANNOTATE

ASSET CLASS
Transportation

ASSET SUBCLASS
Passenger Vehicle

SUBCLASS METADATA
Done

STATE DATA
Done

NOTES
The vehicle was involved in an accident

Submit



Screen Mockup: Annotate State Data Screen

ANNOTATE
STATE DATA

OPERATING STATUS
On

OPERATING MODE
Moving

FAULT STATE
Normal

FAULT COMPONENT
None

FAULT TYPE
None

COMPONENT WEAR STATE
Advanced

COMPONENT WEAR LEVEL
Advanced

Done

ANNOTATE
STATE DATA

OPERATING STATUS
On

OPERATING MODE
Moving

FAULT STATE
Normal

FAULT COMPONENT
None

FAULT TYPE
None

COMPONENT WEAR STATE
Advanced

COMPONENT WEAR LEVEL
Advanced

Done



Screen Mockup: Annotate Screen

ANNOTATE

ASSET CLASS
Transportation

ASSET SUBCLASS
Passenger Vehicle

SUBCLASS METADATA
Done

STATE DATA
Done

NOTES
The vehicle was involved in an accident

Submit

This mockup shows a mobile application screen titled "ANNOTATE". It features a vertical list of form fields, each with a label and a text input area. The fields are: "ASSET CLASS" (Transportation), "ASSET SUBCLASS" (Passenger Vehicle), "SUBCLASS METADATA" (Done), "STATE DATA" (Done), and "NOTES" (The vehicle was involved in an accident). A "Submit" button is located at the bottom. A small black circle is present in the top-left corner of the screen.

ANNOTATE

ASSET CLASS
Transportation

ASSET SUBCLASS
Passenger Vehicle

SUBCLASS METADATA
Done

STATE DATA
Done

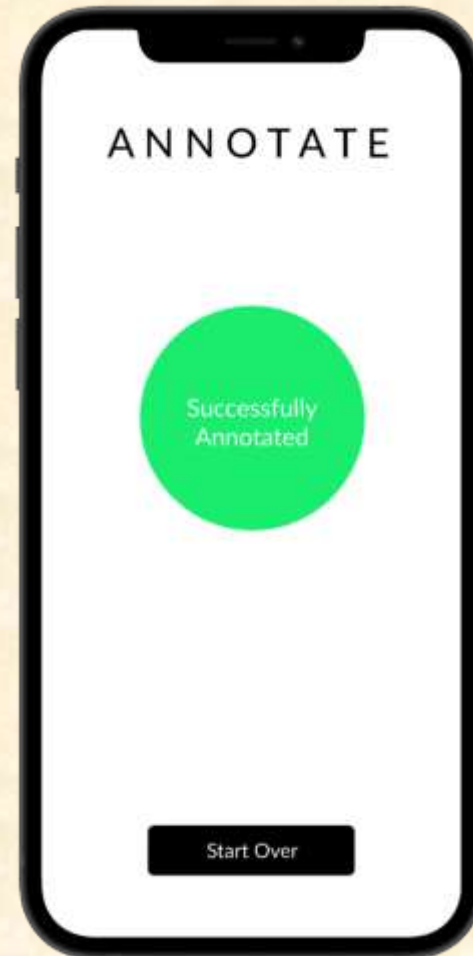
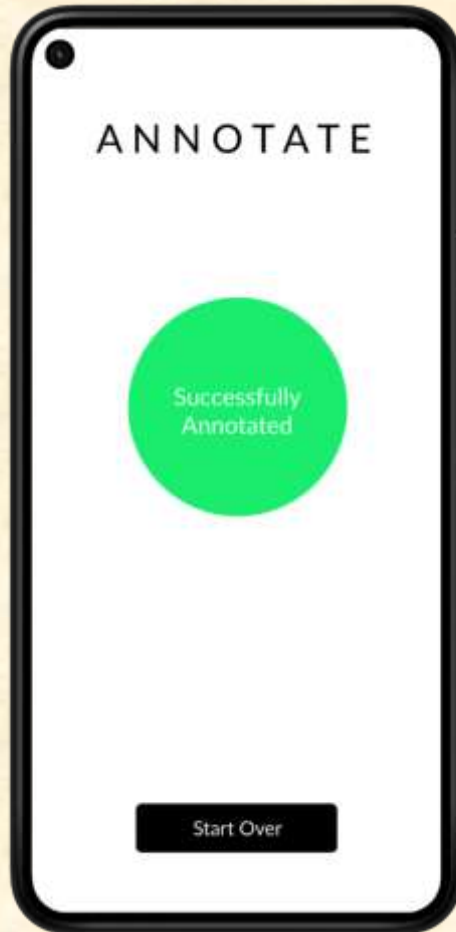
NOTES
The vehicle was involved in an accident

Submit

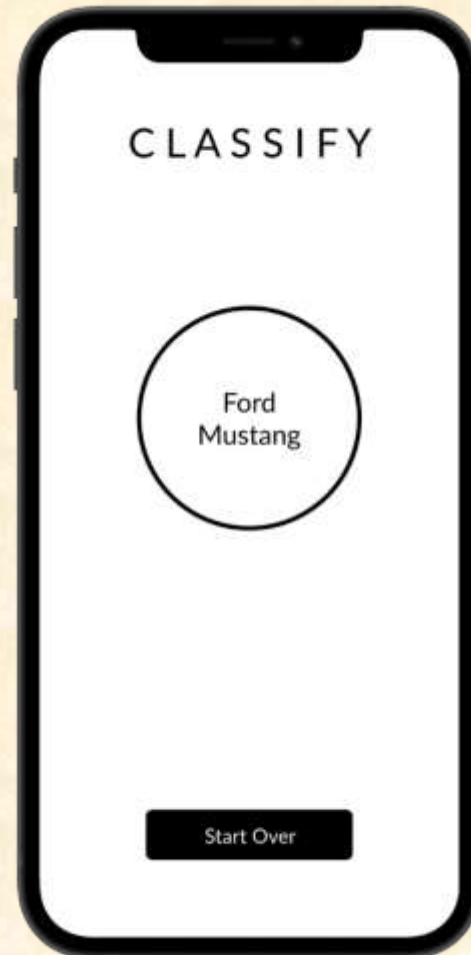
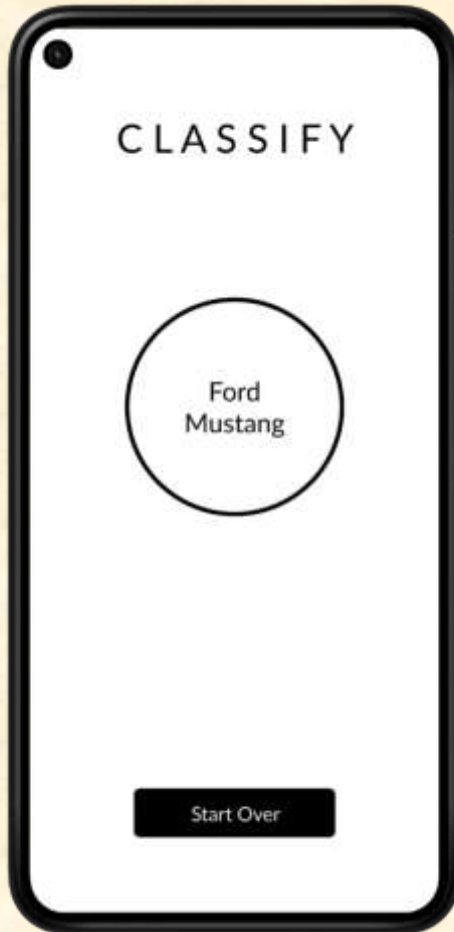
This mockup shows a mobile application screen titled "ANNOTATE". It features a vertical list of form fields, each with a label and a text input area. The fields are: "ASSET CLASS" (Transportation), "ASSET SUBCLASS" (Passenger Vehicle), "SUBCLASS METADATA" (Done), "STATE DATA" (Done), and "NOTES" (The vehicle was involved in an accident). A "Submit" button is located at the bottom.



Screen Mockup: Annotate Submission Screen



Screen Mockup: Classify Screen



Screen Mockup: More Classify Screen

CLASSIFY

ASSET CLASS
Transportation

ASSET SUBCLASS
Passenger Vehicle

MAKE
Ford

MODEL
Mustang

ENGINE
Config: V
Cylinders: 8
Displacement: 289
Aspiration: N

Start Over

CLASSIFY

ASSET CLASS
Transportation

ASSET SUBCLASS
Passenger Vehicle

MAKE
Ford

MODEL
Mustang

ENGINE
Config: V
Cylinders: 8
Displacement: 289
Aspiration: N

Start Over

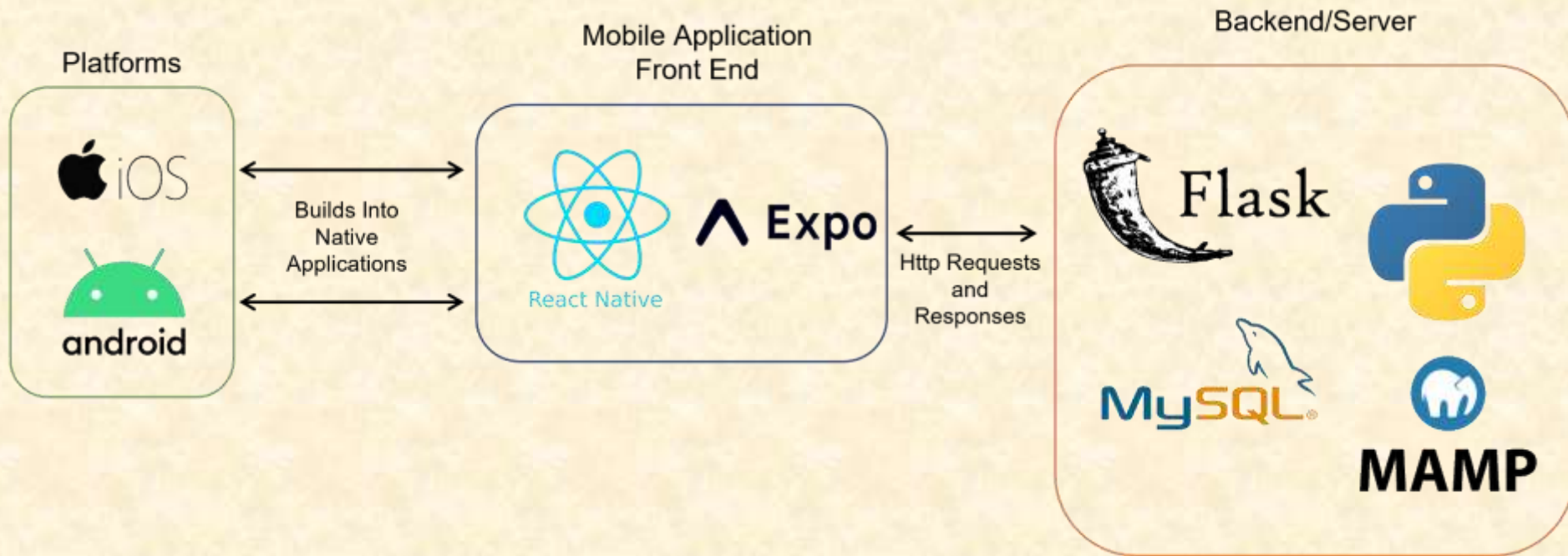


Technical Specifications

- iOS and Android applications built with React Native Expo
 - GUI for users to record, annotate, and view classifications results
 - Captures audio and accelerometer data using built-in sensors and microphone
 - Communicates with the backend through HTTP requests
- Flask server hosted at a specific web URL to run the classification algorithm
- SQL database serves the applications with dynamic annotation labels and stores all data from the users



System Architecture



System Components

- Hardware Platforms
 - Microphone in iOS and Android device
 - Accelerometer in iOS and Android device
- Software Platforms / Technologies
 - React Native Expo
 - Python Flask
 - MySQL
 - MAMP



Risks

- Poorly Annotated Data Collection
 - It is possible that malicious or inexperienced users may annotate samples incorrectly
 - Application access will only be given to trusted users
- Reverse Engineering of Algorithms
 - Machine learning can be used to reverse engineer the algorithm
 - Authentication will be used to prevent unwanted requests
- Annotation Schema Expandability
 - As the number of classifiable systems grows the number of annotation labels also grows
 - Ability to manage the current label numbers is okay for now
- Keeping Track of User Data without Login
 - The database needs to keep track of who sent which audio file when they are being stored without a user login system
 - A unique token or string can be used instead



Questions?

?

?

?

?

?

?

?

?

?

