CRAFT

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Final Presentation

Our Team

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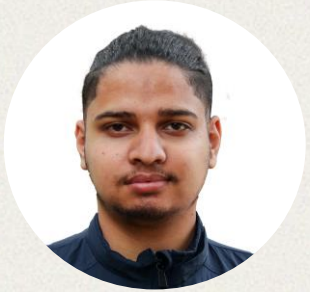
Nicholas Wiley
Team Lead, Release Manager



Aadarsha Bastola
Architect

Kimberly Allison
Client Communicator, Recorder

Vahid Nikoonejad Fard
Team Mentor

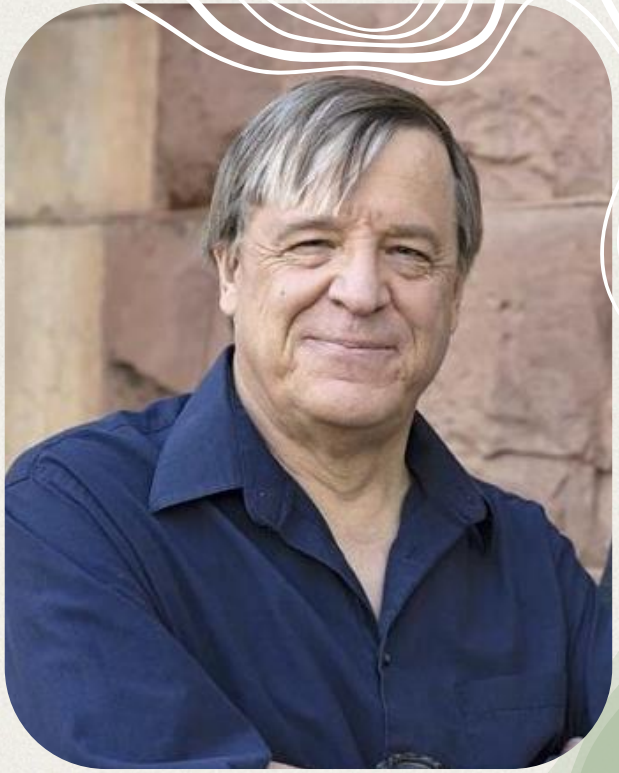
Isaac Schaffer
Course Provider

Our Sponsor:
Dr. Leszek Pawlowicz

- Assistant Research Professor in Department of Anthropology at NAU

- Specializes in applying digital technologies to archaeological problems, focusing on the US Southwest and Belize.

- Recent projects include
    - Virtual tours for Walnut Canyon and Tonto National Monuments.
    - 3D visualization of rock art, Mayan stelae, and elevation models.
    - Award-winning artifact photography system.



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Problem Statement

Problem Statement

- Archeologists are inconsistent with each other
    - Roughly 50% of sherd identifications conflict with others
- Archeologists are inconsistent with themselves
    - Over 50% of new identifications conflict with old ones
- Manually classifying and recording large batches of sherds can be highly inefficient

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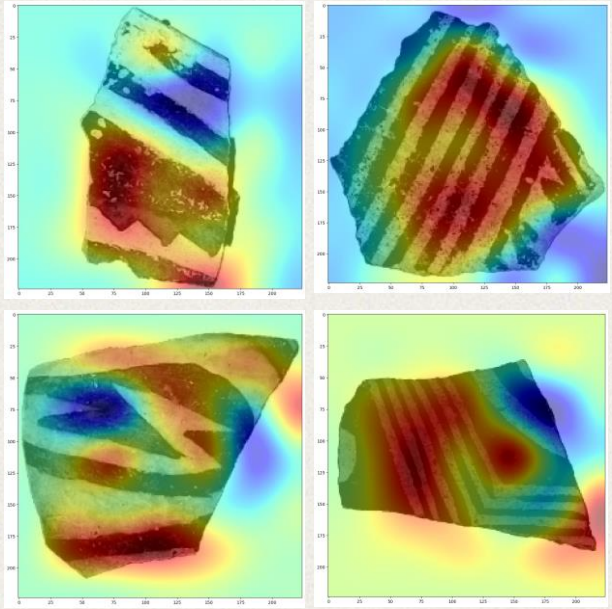
Solution Overview

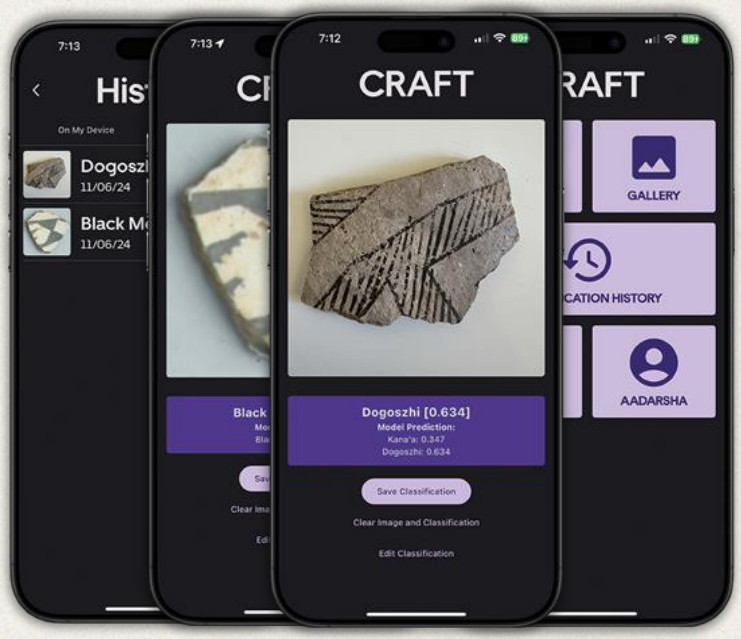
Deep Learning Model

- Provides high accuracy Tusayan White Ware identifications.
- Makes consistent identifications, something even veteran archeologists cannot do.
- Uses a ConvNeXT model to achieve high accuracy and consistency.
- Deployed using TFLite for easy integration into the mobile app and conveyor program.



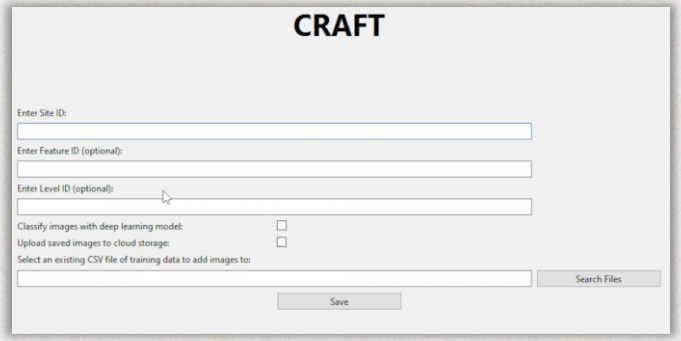
Mobile App

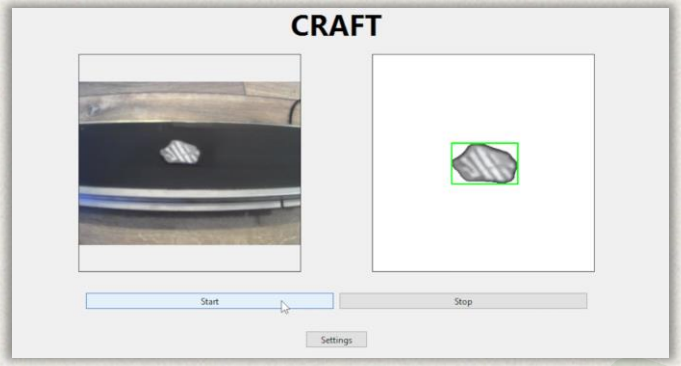
- Making sherd identifications in the field can be hard.
- Mobile App provides on the go classification for sheds.
- Works online and offline for accurate classification in remote environments.
- Automatically archives and stores captured images to the cloud when internet is available.



Conveyor Belt System

- Automatically captures and sherd images.
- Significantly reduces time to capture, upload, and archive sherds.
- Allows for automatic classification of freshly captured sherds.
- Integrates captured data into image model file system smoothly.





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Project Requirements

Deep Learning Model

Highest Possible Practical Accuracy

- Improved accuracy from client's previous model

Highest Possible Consistency

- Improved consistency in classifying sherds

Lightweight Model for Production

- Creation of a lightweight TFLite model

Mobile Application

Classifies Images

- From gallery and camera

Offline Functionality

- Offline storage options

Edit Classification Result

- Override classification result

Location Services

- Obscure location data

Uploads images and data to cloud storage

- Upload full resolution image and metadata

Conveyor Belt System

Bulk image processing

- Real time image pre-processing

Realtime Data Collection

- Archive images of known sherds in bulk for future training

Classifies Images

- Real time classification while the conveyor belt is running

Uploads images and data to cloud storage

- Uploads full resolution image and metadata for archival purposes

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Architecture and Implementation

Deep Learning Model

ConvNeXt

- Premade from Keras framework

Dataset

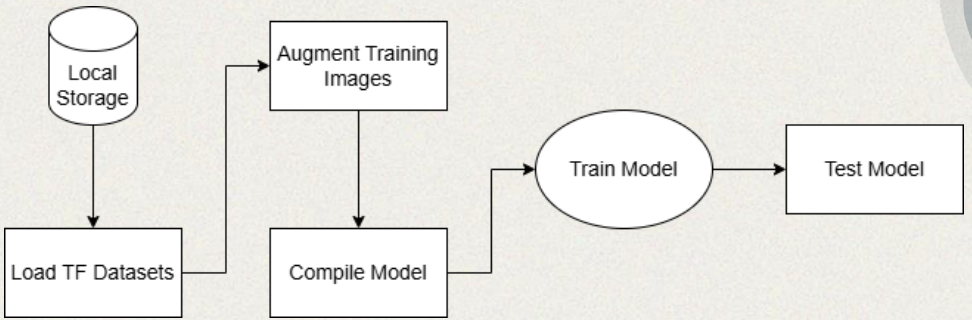
- Images split into training and testing datasets with consistent class distribution

Training

- Transfer learning applied to base ConvNeXt model

Validation

- Test dataset used to test model every epoch



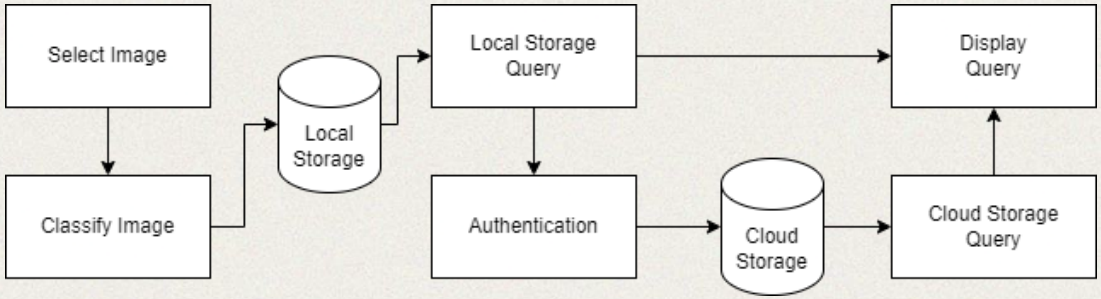
Mobile Application

Flutter
- Cross platform mobile app development framework
- Single codebase

Firebase
- Authentication (Firebase Auth)
- Database (Firebase Firestore)
- Storage Bucket (Firebase Storage)

TFLite
- Lightweight TensorFlow Model Integration
- Cross Platform Support

Hive
- Lightweight blazing fast database for local storage



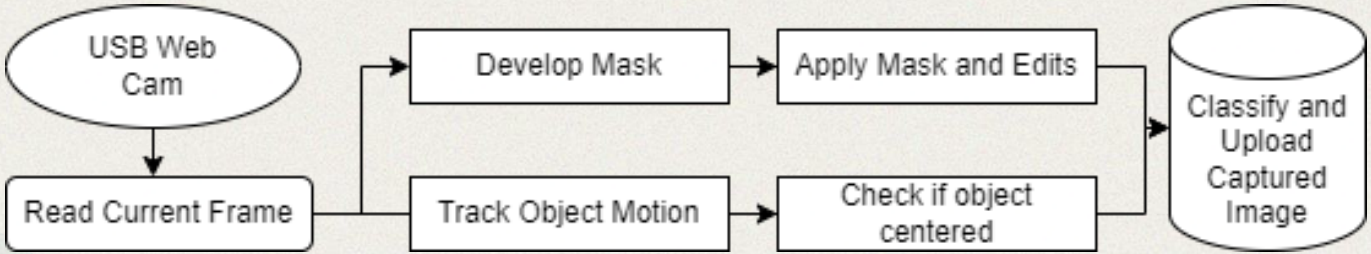
Conveyor Belt System

OpenCV
- Computer Vision Library for Python
- Real time classification while the conveyor belt is running

Firebase
- Database (Firebase Firestore)
- Storage Bucket (Firebase Storage)

TensorFlow Model Integration
- Automatic classification using our custom trained light version of our TensorFlow Model

PySide
- Responsive user interface
- Multi-threaded implementation allows for concurrent processing of video and captured images



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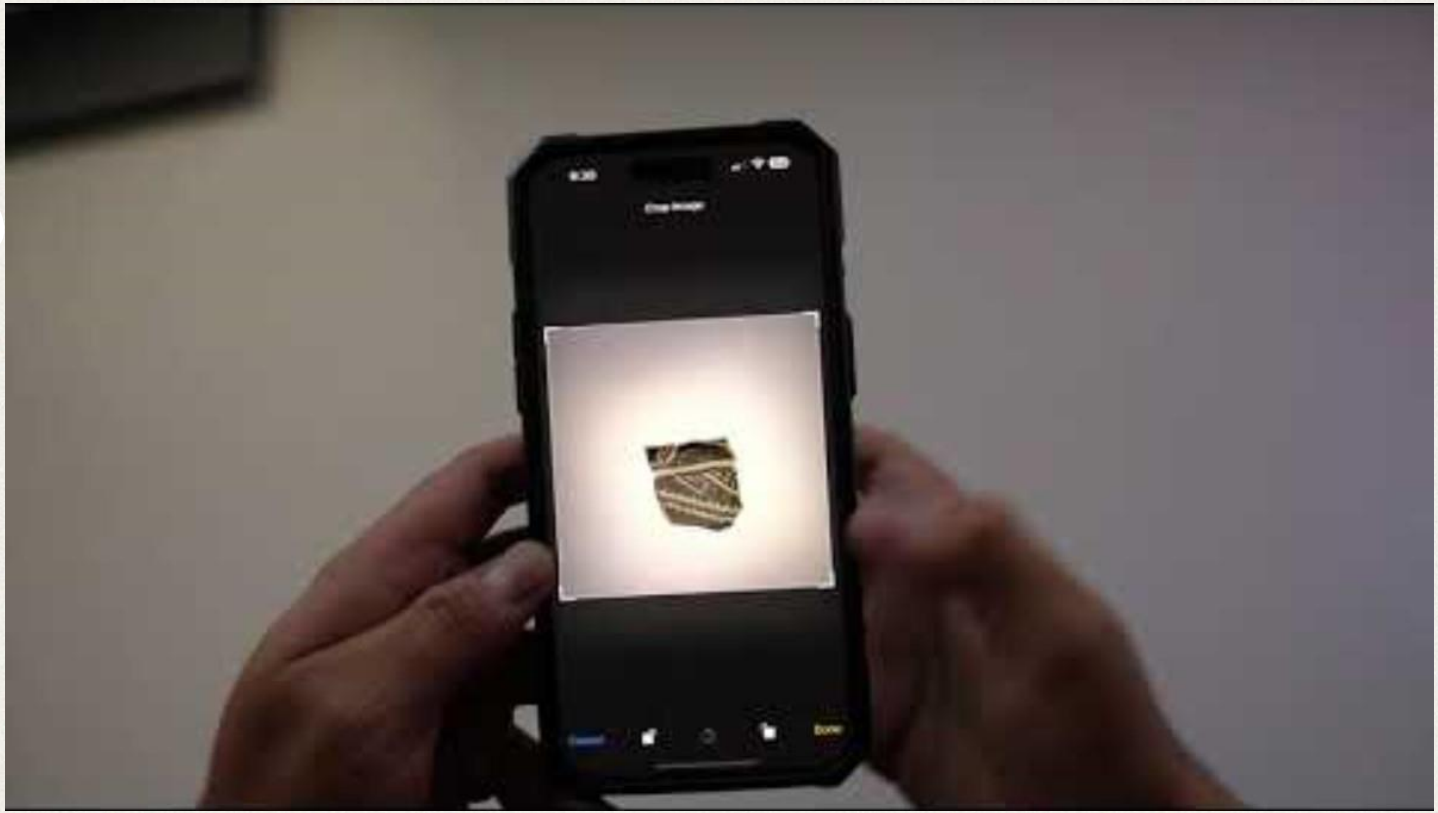
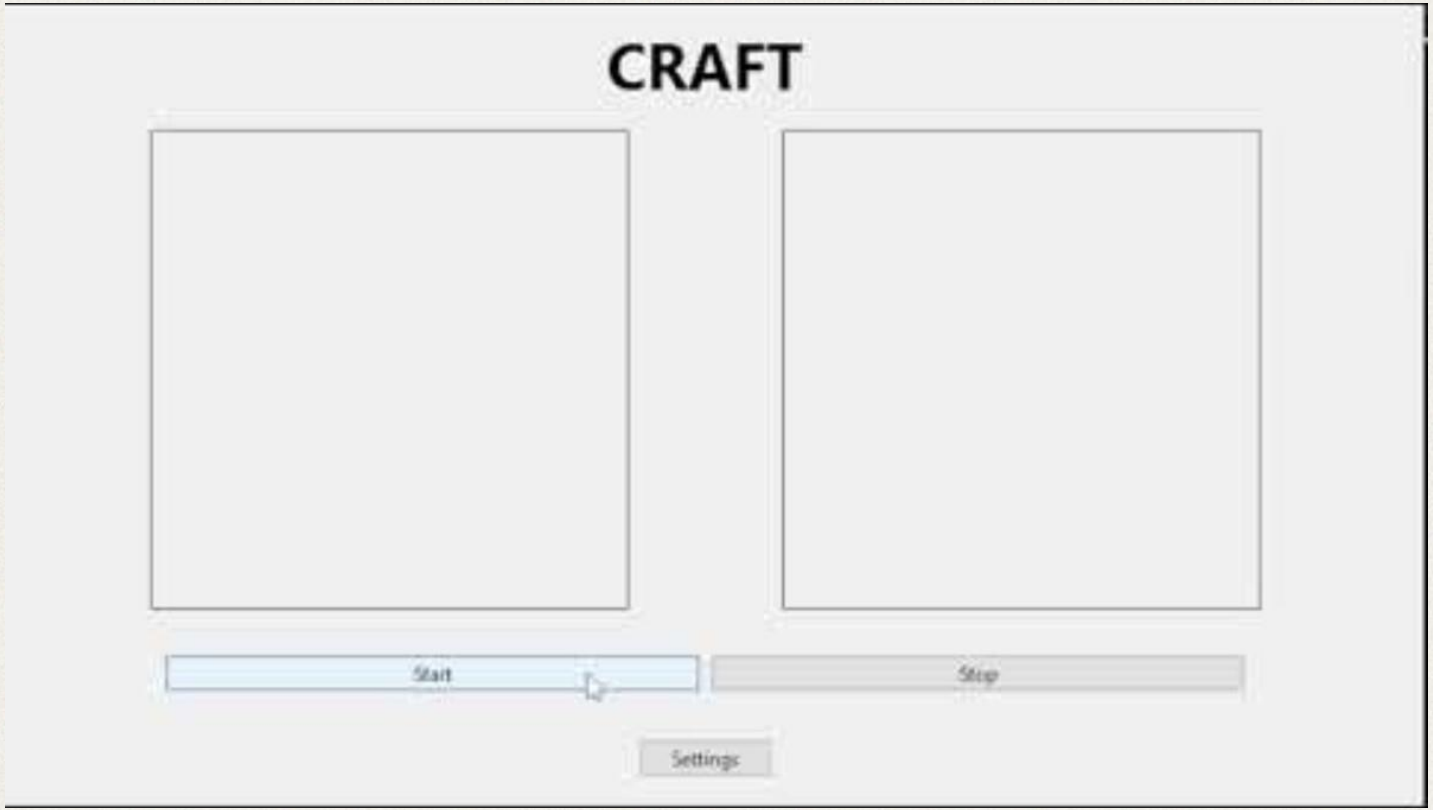
Prototype Review

Mobile App Demo



Conveyor Belt System Demo



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Challenges and Resolutions

Challenges

Mobile app performance degrades on older hardware

- Classifying sherds results in noticeable lag

Conveyor belt program results are impacted by quality of light

- Harsh light washes out images

Deep learning best practices do not improve our models

- Little to no improvement from original models

Resolutions

Mobile app lags on older hardware

- Code running deep learning model optimized

Conveyor belt susceptible to harsh light

- Light box to block outside light

Deep learning models not improving through best practices

- Hyperparameters optimized

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Testing Plan

Deep Learning Model

Unit Testing

- Validate input data preprocessing
- Verify correct dataset creation

Integration Testing

- Test TensorFlow Lite model integration with the conveyor belt program and mobile app
- Verify image classification results are correctly displayed

Mobile Application

Unit Testing

- Test user authentication
- Test TensorFlow Lite model loading and image classification
- Test image upload and data storage in Firebase

Integration Testing

- Test Firebase authentication flow (login, registration, logout)

Usability Testing

- Test overall user experience for non-tech-savvy users
- Test classification editing functionality

Conveyor Belt System

Unit Testing

- Test object detection at the webcam center
- Validate image capture, storage, and log setup.

Integration Testing

- Check database integration

Usability Testing

- Assess user interaction with image previews and highlight functionality

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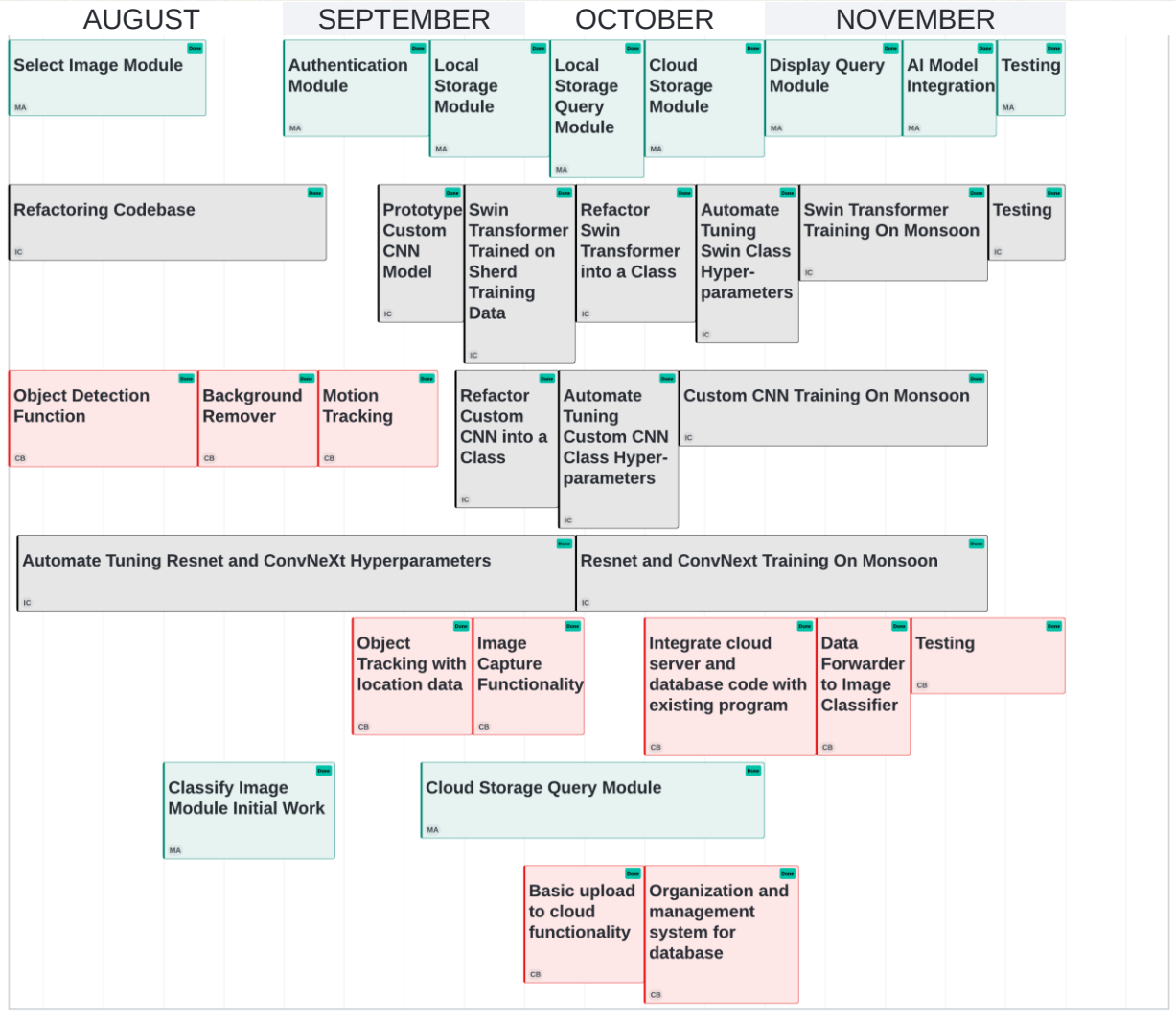
Schedule

Project Timeline



- AI Model
- Conveyor Belt System
- Mobile App

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Future Work

Future Work

- Use Conveyor belt to collect more data
- Train the AI with more data to further increase accuracy
- Deployment of the mobile app in Google Play Store and Apple App Store

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Conclusion

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Problem

Archaeologists struggle to classify sherds consistently and quickly

Solution

- Deep Learning Model
- Mobile App
- Conveyor Belt System

Impact

CRAFT project will speed up field work and gathering data and consistency in sherd classification

Team CRAFT aims to **bring a revolution** in the field of archaeology using our AI model, mobile app and the conveyor belt system.

Thanks

Do you have any questions?


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