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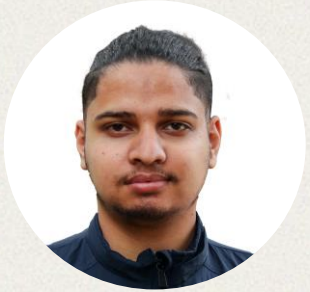
Design Review

Our Team

Alan Hakala
Quality Assurance

Nicholas Wiley
Team Lead, Release Manager



Aadarsha Bastola
Architect

Kimberly Allison
Client Communicator, Recorder

Vahid Nikoonejad Fard
Team Mentor

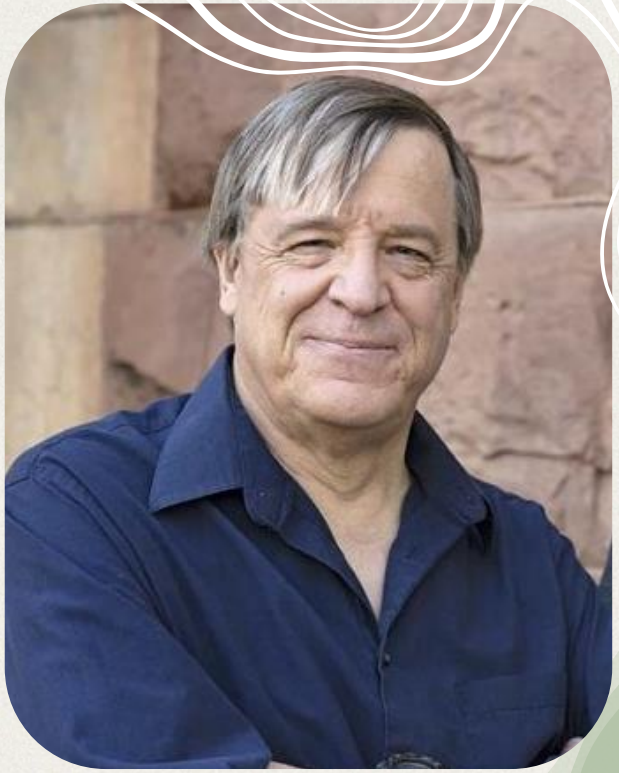
Isaac Schaffer
Course Provider

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

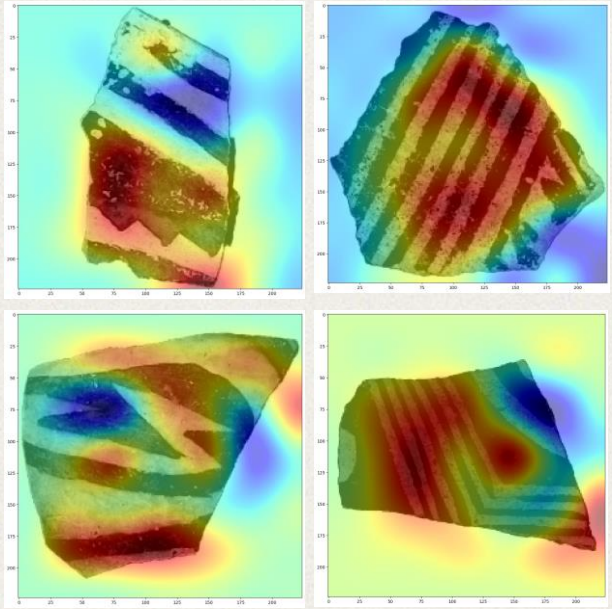
- Archeologists are inconsistent with each other
    - Roughly 50% of sherd identifications conflict with others
- Archeologists are inconsistent with themselves
    - Over 50% of new identifications conflict with old ones
- Manually classifying and recording large batches of sherds can be highly inefficient

02

Solution Overview

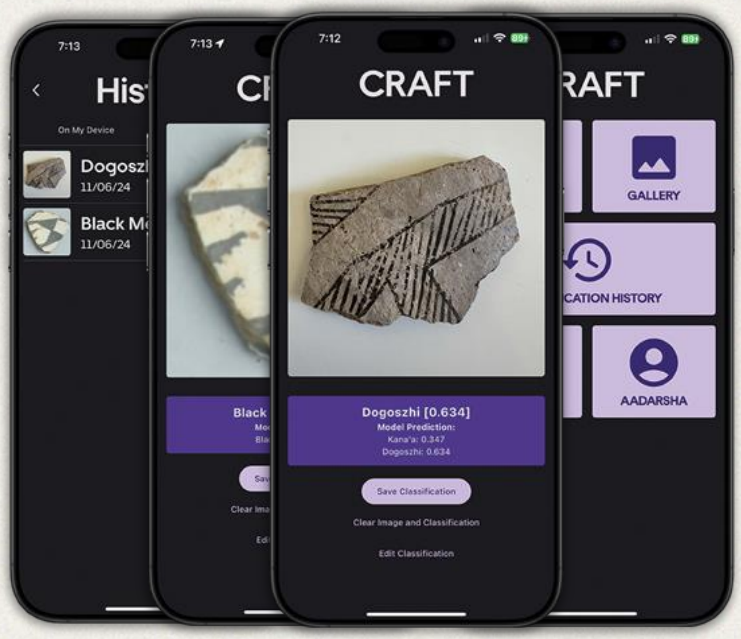
Deep Learning Model

- 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.



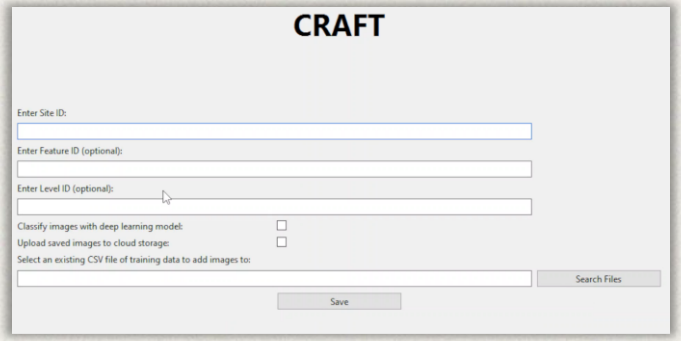
Mobile App

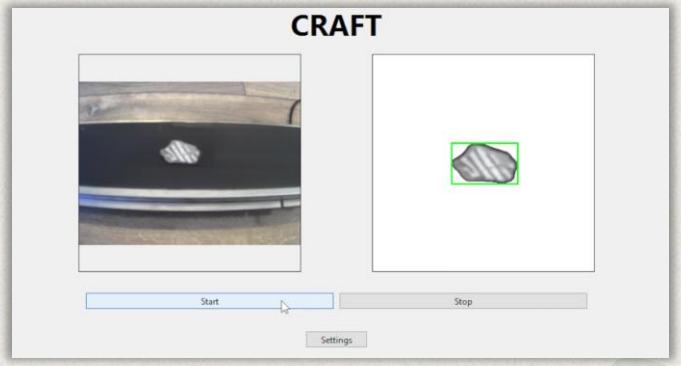
- Making sherd identifications in the field can be hard.
- Mobile App provides on the go classification for sheds.
- Works online and offline for accurate classification in remote environments.
- Automatically archives and stores captured images to the cloud when internet is available.



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

04

Implementation Overview

Deep Learning Model

ConvNeXt

- Premade from Keras framework

Training

- Transfer learning applied to base ConvNeXt model

Dataset

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

Validation

- Test dataset used to test model every epoch

Mobile Application

Flutter

- Cross platform mobile app development framework
- Single codebase

TFLite

- Lightweight TensorFlow Model Integration
- Cross Platform Support

Firebase

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

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

TensorFlow Model Integration

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

Firebase

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

PySide

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

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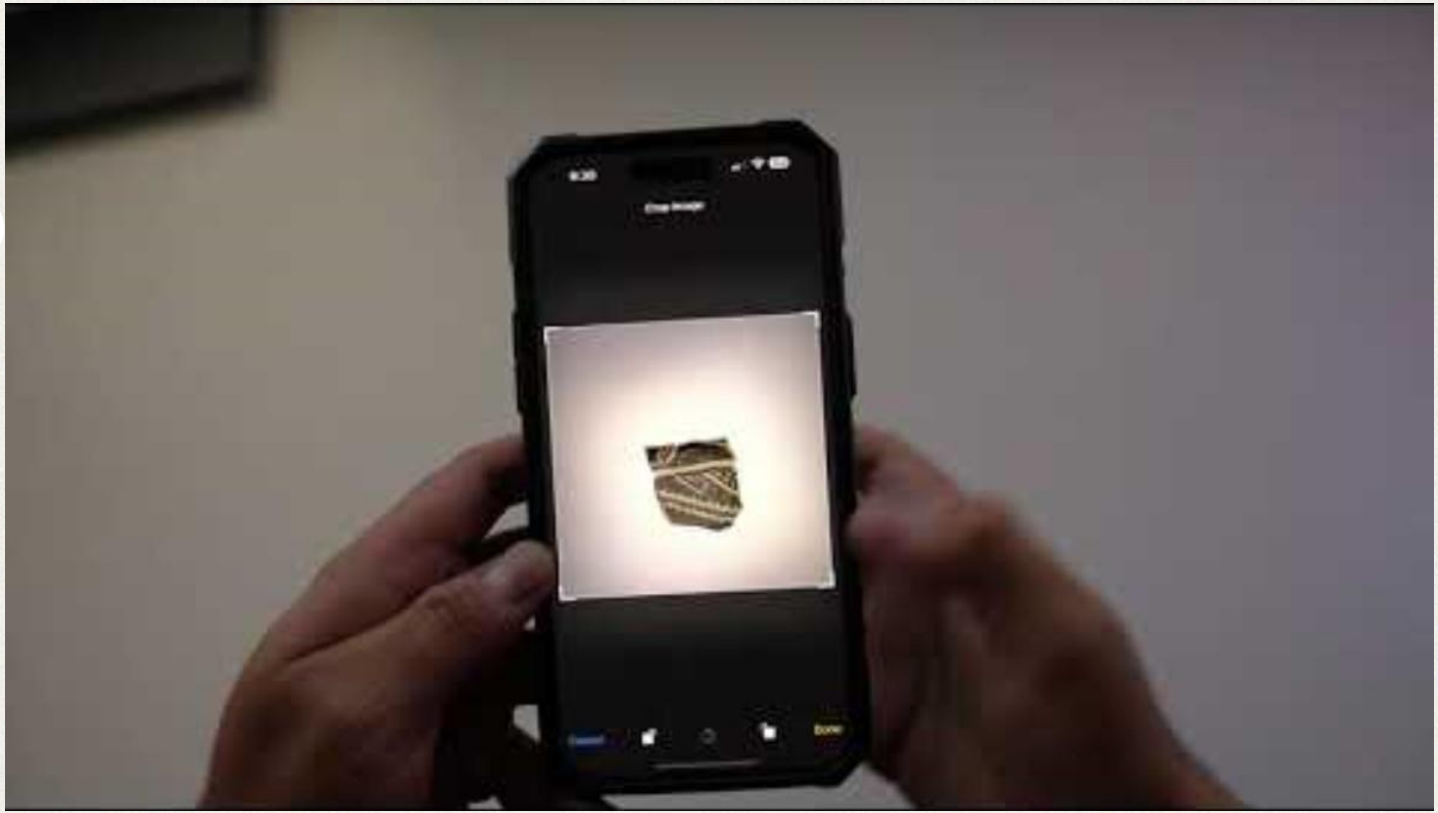
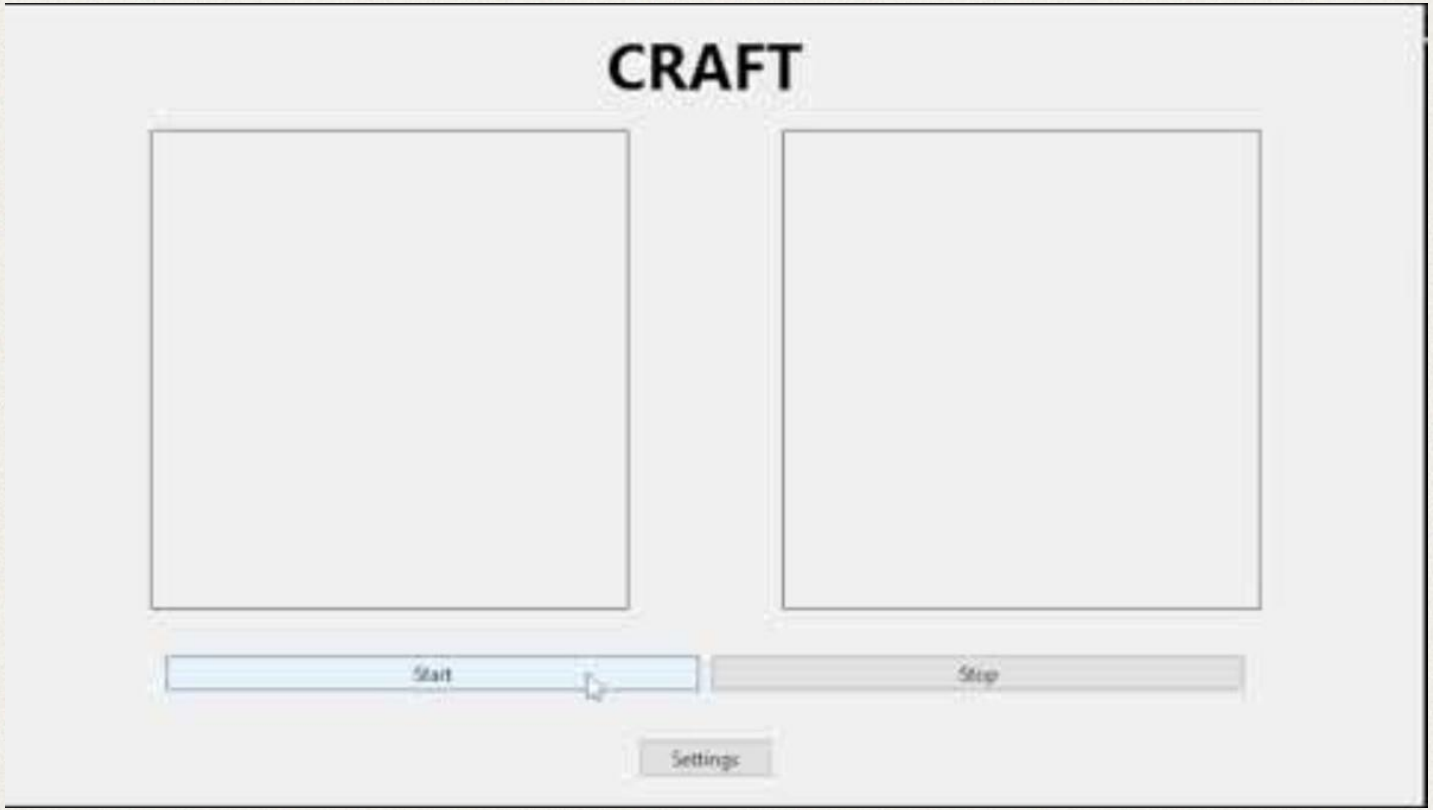
Prototype Review

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

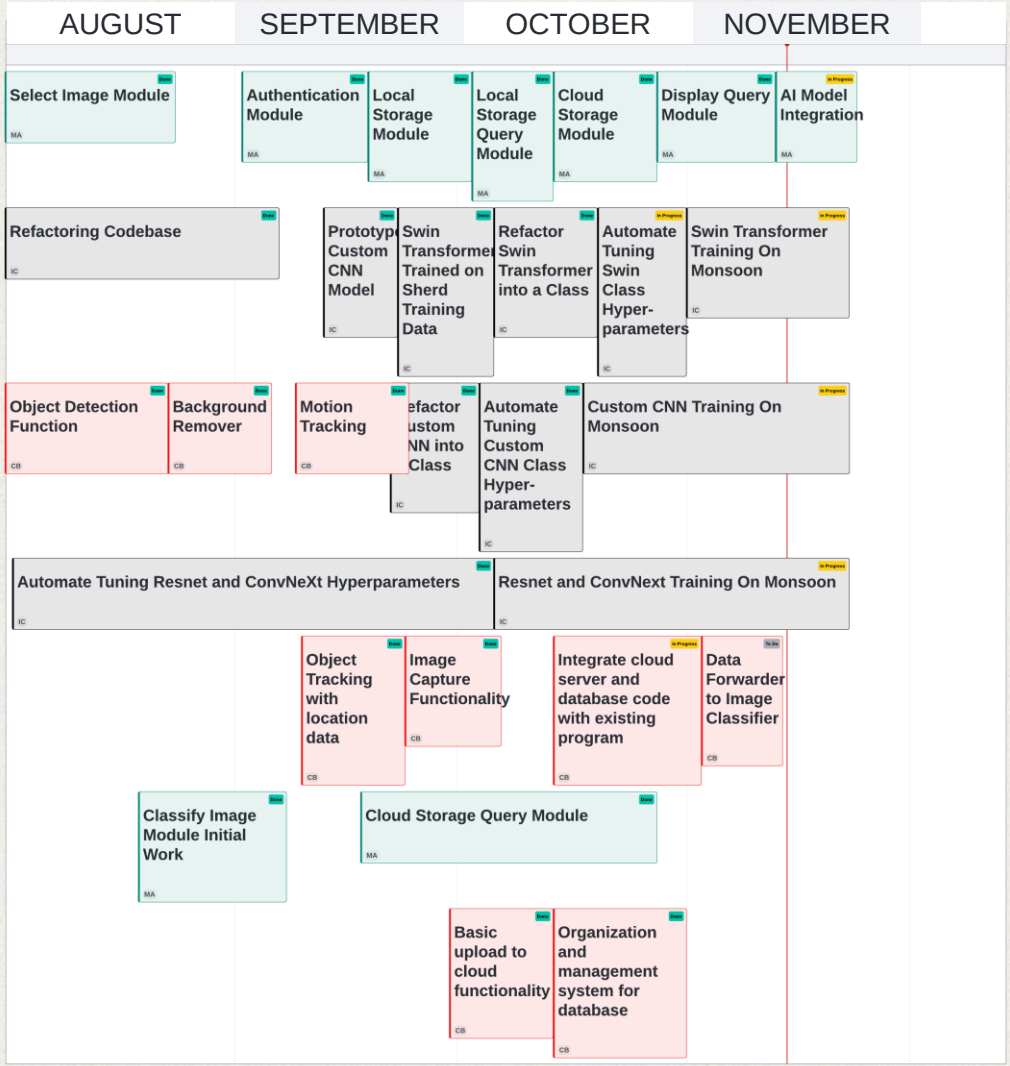
- Check database integration

Usability Testing

- Assess user interaction with image previews and highlight functionality

08

Schedule



Gantt Chart

- AI Model
- Conveyor Belt System
- Mobile App

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Conclusion

Conclusion

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?