MICHIGAN STATE UNIVERSITY

Project Plan Presentation

Recycling Identification Scanner

The Capstone Experience

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From Students…
…to Professionals

Project Sponsor Overview

- General Motors (GM) is a multinational car manufacturer headquartered in Detroit, Michigan
- GM is in the forefront of innovation when it comes to car manufacturing
- GM is moving towards electric vehicle manufacturing in line with their goals of carbon neutrality by 2040, and all renewable energy in its US facilities by 2025

Project Functional Specifications

- It’s important to organize plastics by type because they have different properties
- Plastics throughout the facility can’t always be identified by sight alone
- Our scanner uses infrared light and measures reflectance and accurately identify plastics
- The system integrates with a mobile app for simple and efficient logging
- Its features align with GM’s existing recycling procedures
- The scanner can be retrained as new plastics are introduced with new car models

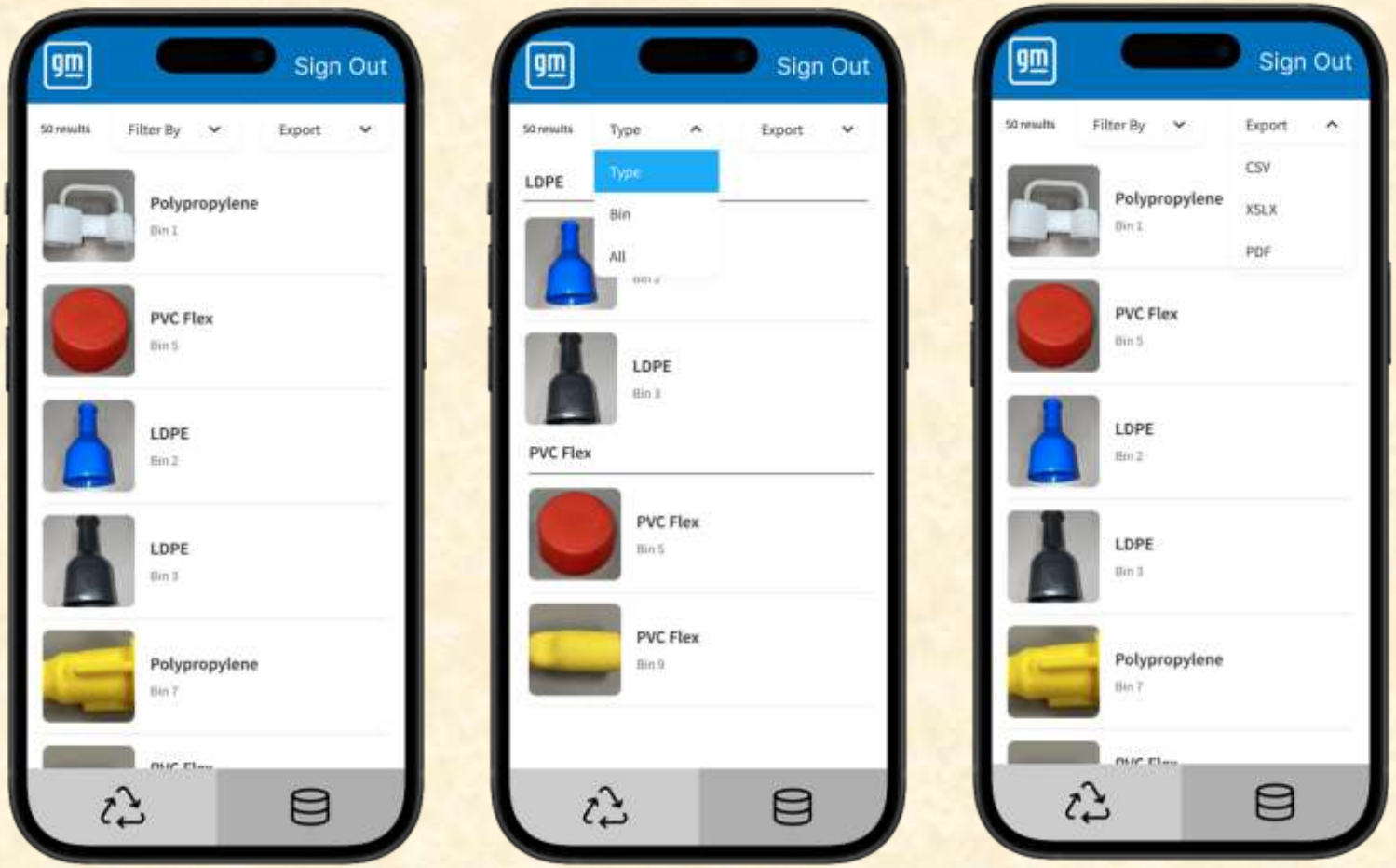
Project Design Specifications

- Scan plastic with scanner, view plastic type on phone and optionally add an image
- A page for all the plastic data which can be sorted by type and bin
- All plastic data can be exported in multiple formats
- Training mode for admin use, prompting user to respond yes/no when scanning new plastic

Screen Mockup: Home Page

Screen Mockup: Scan Pages

Screen Mockup: Plastic Data

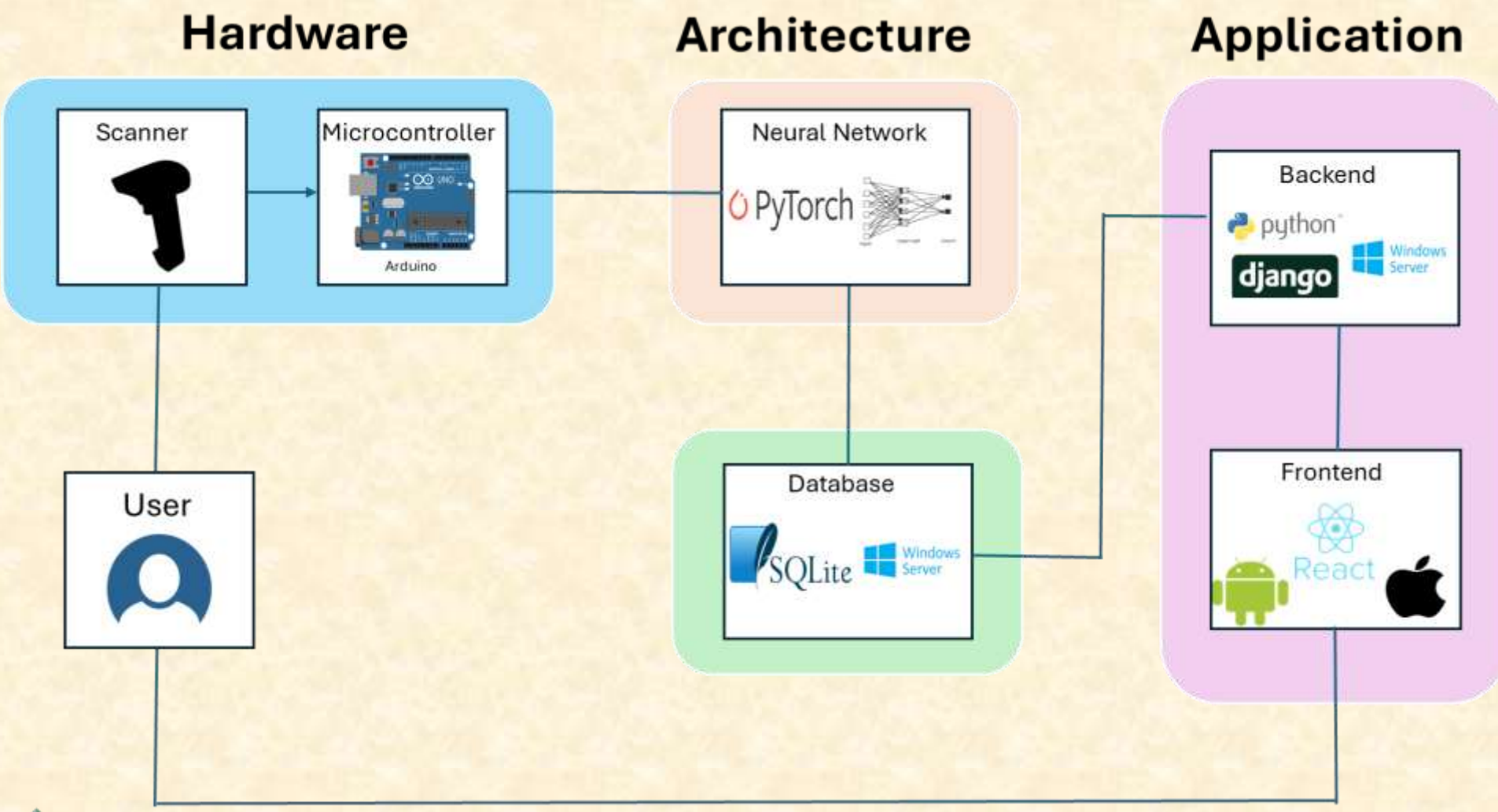


Screen Mockup: Train Mode

Project Technical Specifications

- **Arduino Microcontroller**: Controls the LEDs, photodiode, and runs the model. Emits data to mobile device
- **Near-Infrared Spectroscopy**: Emits near-infrared light from 8 LEDs and measures how much is reflected using a photodiode
- **Machine Learning Model**: Neural network built with PyTorch is trained on spectral data. Outputs probability of each plastic type
- **Mobile Application**: Built with React Native for iOS and Android, communicates with the scanner to display results
- **Data Storage**: Results are stored locally using SQLite and synced with a Django-powered cloud backend
- **Wireless Communication**: Data is transmitted via Bluetooth or Wi-Fi between the scanner and the mobile app
- **Cloud Backend**: Manages data storage, model updates, and feedback loops using Django and GM servers

Project System Architecture



Project System Components

- Hardware Platforms
  - Plastic Scanner
    - Arduino Uno
    - Circuit Board
    - LEDs and Photodiode
    - Mobile Device
- Software Platforms / Technologies
  - Programming Languages
    - Python
    - JavaScript
    - SQLite
  - Libraries/Modules
    - Django
    - React Native
    - SQLite3
    - Pytorch
    - Pandas

Project Risks

- Dataset
  - Needs to be large, diverse, and accurate for a good model
  - Open source? Creating it ourselves
- Handling Composite Plastics
  - Some materials can be composed of multiple different types of plastics
  - Treating composites as a different plastic type and including it in the dataset
- Extrapolate To New Plastics
  - The scanner should be scalable and should be able to identify new types of plastics
  - A large and diverse dataset. A manual training mode (“Is this [plastic type]? [Yes/No]”)
- On-Device Compute
  - Running a neural network can be expensive
  - Multiple manual testing. Cloud compute if necessary