Carnegie Mellon University

Understanding and Dispensing Ingredients for Smart Robotic Cooking

Progress Review 7

Team B - Ratatouille Robotics

Goals for PR7

Goals	Status
Evaluate SVD and Revise Schedule for FVD	
Evaluate the need for additional shelves / racks	
Design the first iteration of the spectral camera mount	
Setup spectral camera, test remote trigger and collect data of non-perishable ingredients.	

Goals for PR4

Goals	Status
Evaluate SVD and Revise Schedule for FVD	✅
Evaluate the need for additional shelves / racks	
Design the first iteration of the spectral camera mount	
Setup spectral camera, test remote trigger and collect data of non-perishable ingredients.	

Fall 2022 - Schedule

TASK	NO. OF WEEKS	September W36 9/5	W37 9/12	W38 9/19	W39 9/26	October W40 10/3	W41 10/10	W42 10/17	W43 10/24	W44 10/31	W45 11/7	W46 11/14	W47 11/21
Hardware													
Identify and finalize shelf requirements	1												
Identify and order Cooking Pot	4												
Stand / Mount for the cooking pot	4												
Sensing station - Spectral Camera Mount & Weighing Scale	5												
Perception													
Revamp the ingredient classification model													
- Automated data collection script	1												
- Data without tags, varying fill levels	2												
- Train the model	2												
Spectral Data Integration into Ingredient Validation													
- Data Collection	3												
- Integration & Testing	5												
Planning													
Develop Calibration Routine	3												
Update State Machine for New WorkFlow	2												
URDF model with new collision objects	3												
Control													
PID Controller													
- Develop Controllers for Powders	2												
- Tune all ingredients	3												
Residual Policy Learning													
- Learning Framework Formulation	3												
- Data Collection & Setup	6												
- Training & Experimentation	4												
Final Controller Finetuning	3												
Miscellaneous													
New UI for getting user recipe													
Integration & Testing													
Media Generation													
Demonstration Preparation													

Progress Review 7 · Progress Review 8 · Progress Review 9 · System Development Review · Progress Review 10 · Progress Review 11 · Fall Validation Demonstration

Goals for PR4

Goals	Status
Evaluate SVD and Revise Schedule for FVD	✅
Evaluate the need for additional shelves / racks	✅
Design the first iteration of the spectral camera mount	
Setup spectral camera, test remote trigger and collect data of non-perishable ingredients.	

Reconfigured Shelves

- Upgrade dispensing capability to 15 containers
  - Increase capacity of shelf to hold extra 9 containers, reworked shelf levels
  - Rework motion sequences to accommodate closely packed containers and shorter shelves

- Optionally extendable to 18 ingredient containers: More than 18 ingredients, out of scope for FVD

  No need for additional shelves/racks

- Pick and Place pipeline tested with all new positions

Goals for PR4

Goals	Status
Evaluate SVD and Revise Schedule for FVD	✅
Evaluate the need for additional shelves / racks	✅
Design the first iteration of the spectral camera mount	✅
Setup spectral camera, test remote trigger and collect data of non-perishable ingredients.	

Sensing Station

Goals for PR4

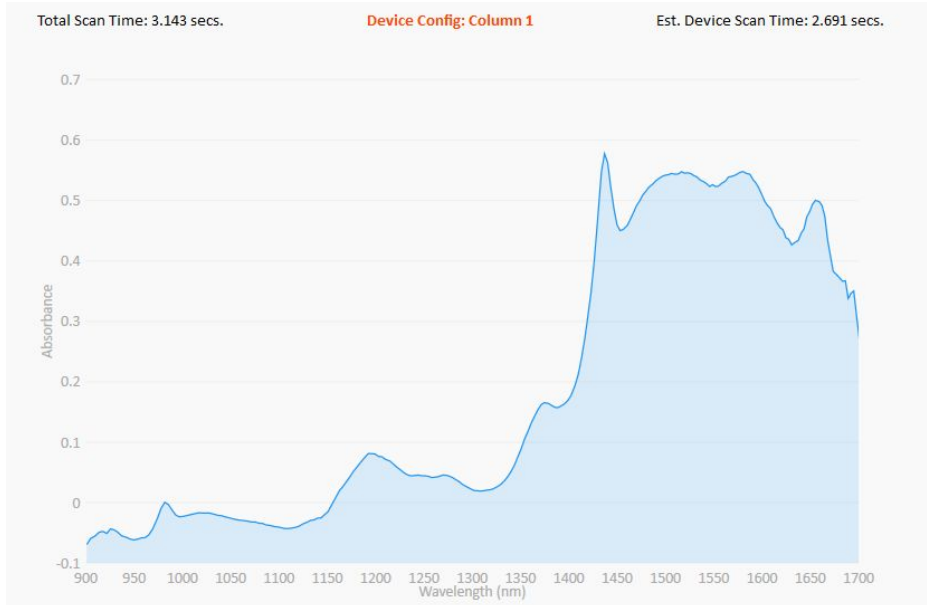| Goals	Status
Evaluate SVD and Revise Schedule for FVD	✅
Evaluate the need for additional shelves / racks	✅
Design the first iteration of the spectral camera mount	✅
Setup spectral camera, test remote trigger and collect data of non-perishable ingredients.	✅

Spectral Camera

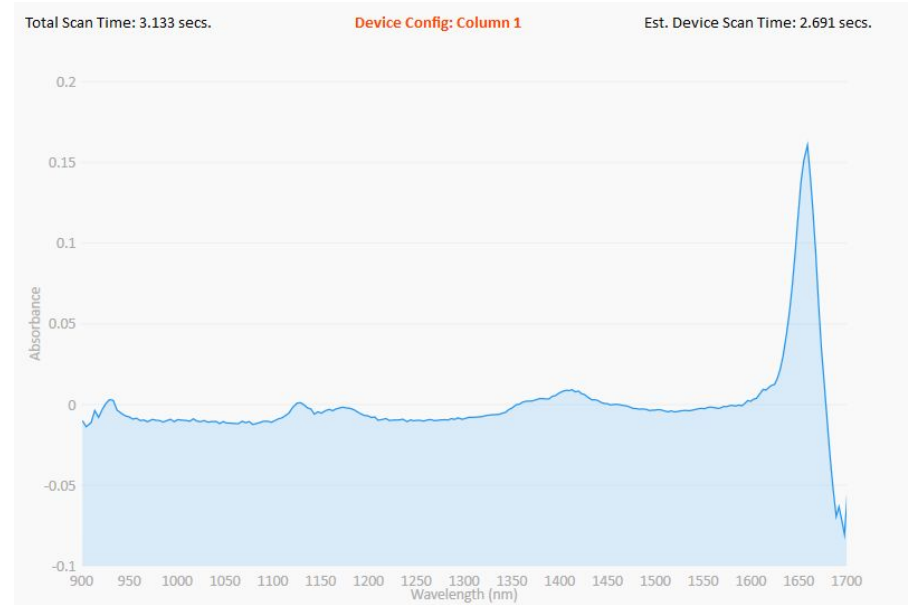- Windows SDK Setup and Remote Trigger of Scan: Complete
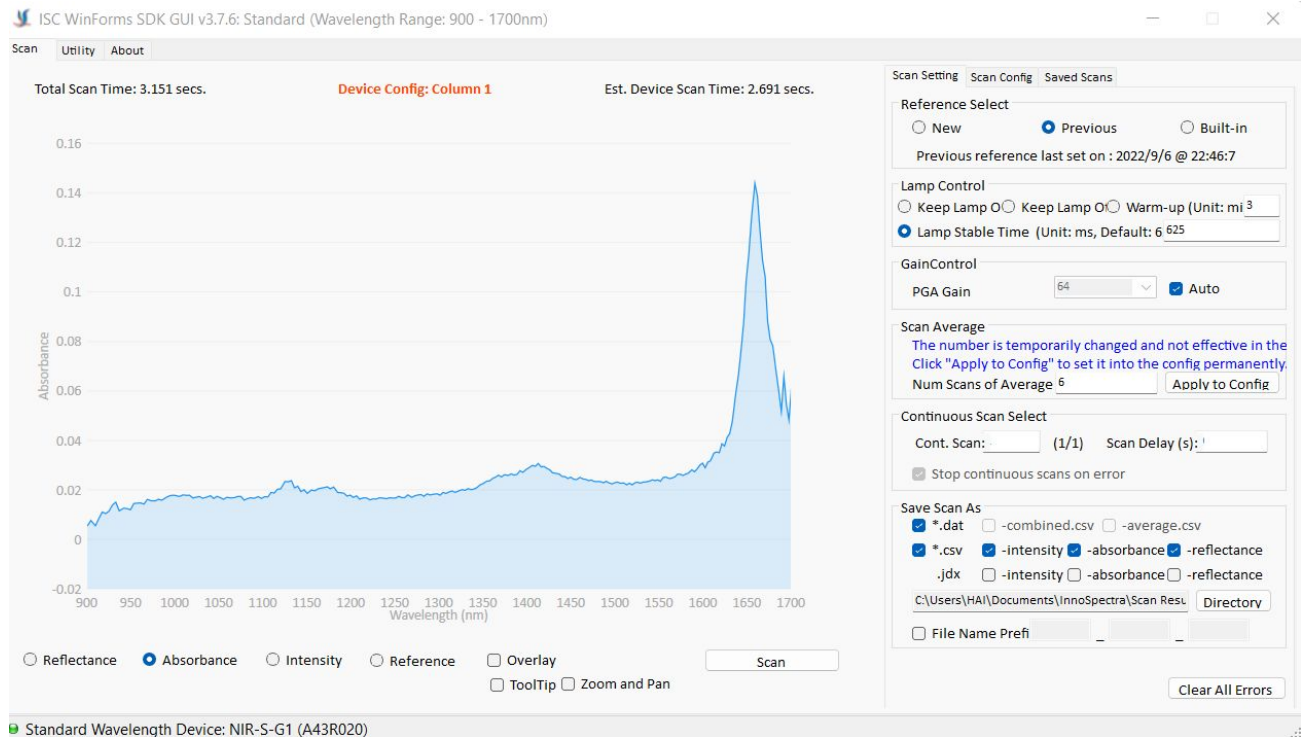
Spectral Camera: Data Collection

Sugar

Salt

[Sample absorbance data](#)

Spectral Camera: Challenges

- NIRVascan only has Windows SDK for the device.

  Action: Need to add an additional Windows PC to our setup to take spectral readings.

- NIRVascan's Cloud allows usage only through UI and API is to be paid for. API calls may also be time consuming.

  Action: Need to develop a local database of ingredients and perform PCA locally to avoid delays and avoid purchasing API access.

Challenges

- Containers for liquids require extra-height shelves due to nozzle on top
  - Solution: Placed liquids on the top shelf

- While moving out after picking up a container placed at an angle, robotic arm tips over adjacent container.
  - Solution: Arm needs to back out perfectly perpendicular to the shelf to avoid tipping over adjacent containers. Use sequential motions along axis to navigate while moving to ingredient positions and back out.

FVD - Recipe

- Identified a recipe to prepare for FVD
- Prepared the same according to weight proportions in order to ensure if the ingredient quantities made sense

Future Work

- Order Cooking Pot

- Test Sensing Station

- Initial Calibration Pipeline/Flow

- Dispense Powdered Ingredients

- Tune dispensing for all ingredients

- Perform sorting of ingredients using spectral data

- Improve image classification pipeline`

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Questions?