Dwight Look College of ENGINEERING
TEXAS A&M UNIVERSITY

Team 2: Robotic Sorting System
Bi-Weekly Update 4

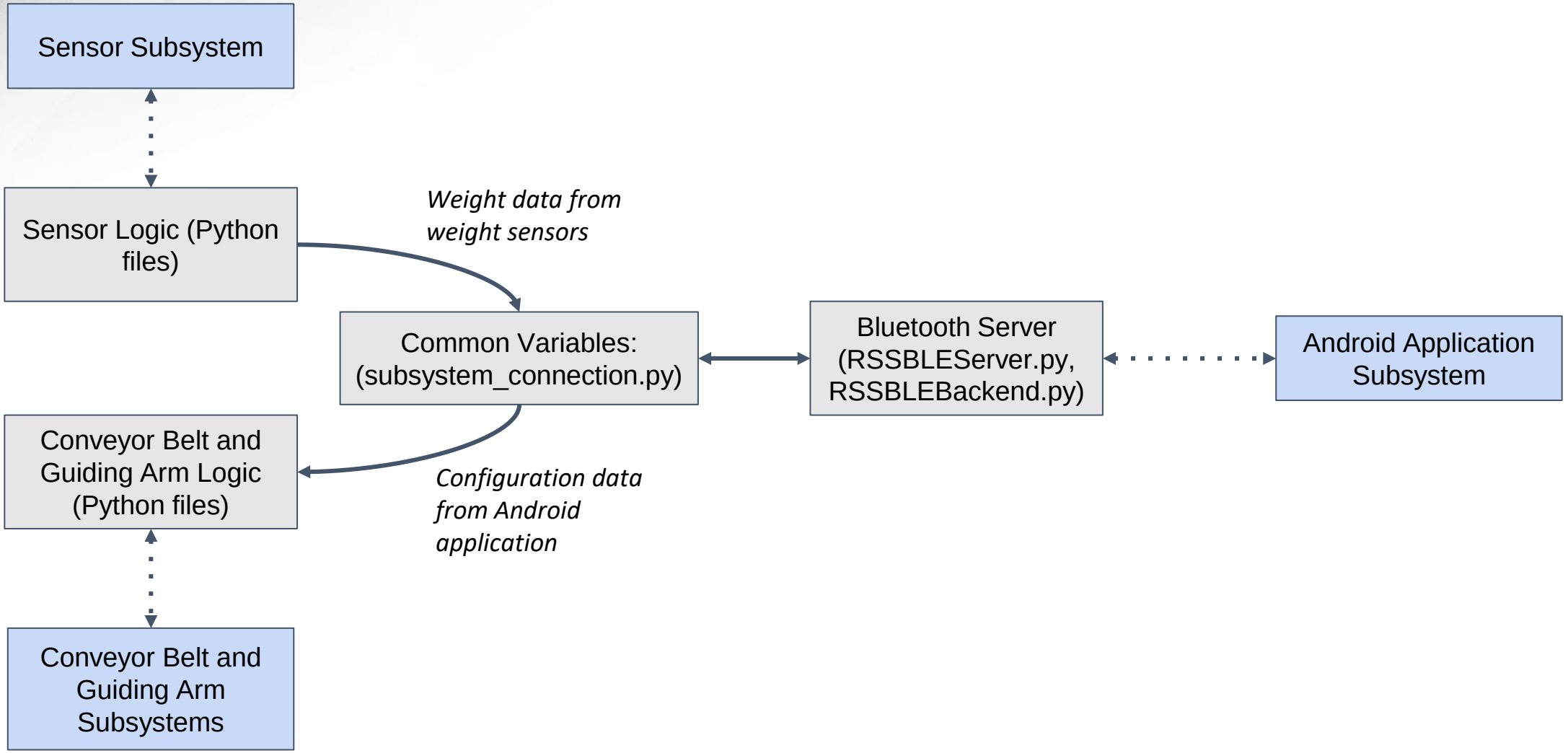
Pace Dominy, Joseph Miller, Lam Tran
Sponsor: Dalton Cyr
TA: Swarnabha Roy

Project Description

Sorting fruit by hand can be tedious and expensive.

The Robotic Sorting System is an automatic sorting system that requires limited manpower/oversight that can accurately sort fruit by their size and quality without the user having to do it themselves.

Integrated System Diagram



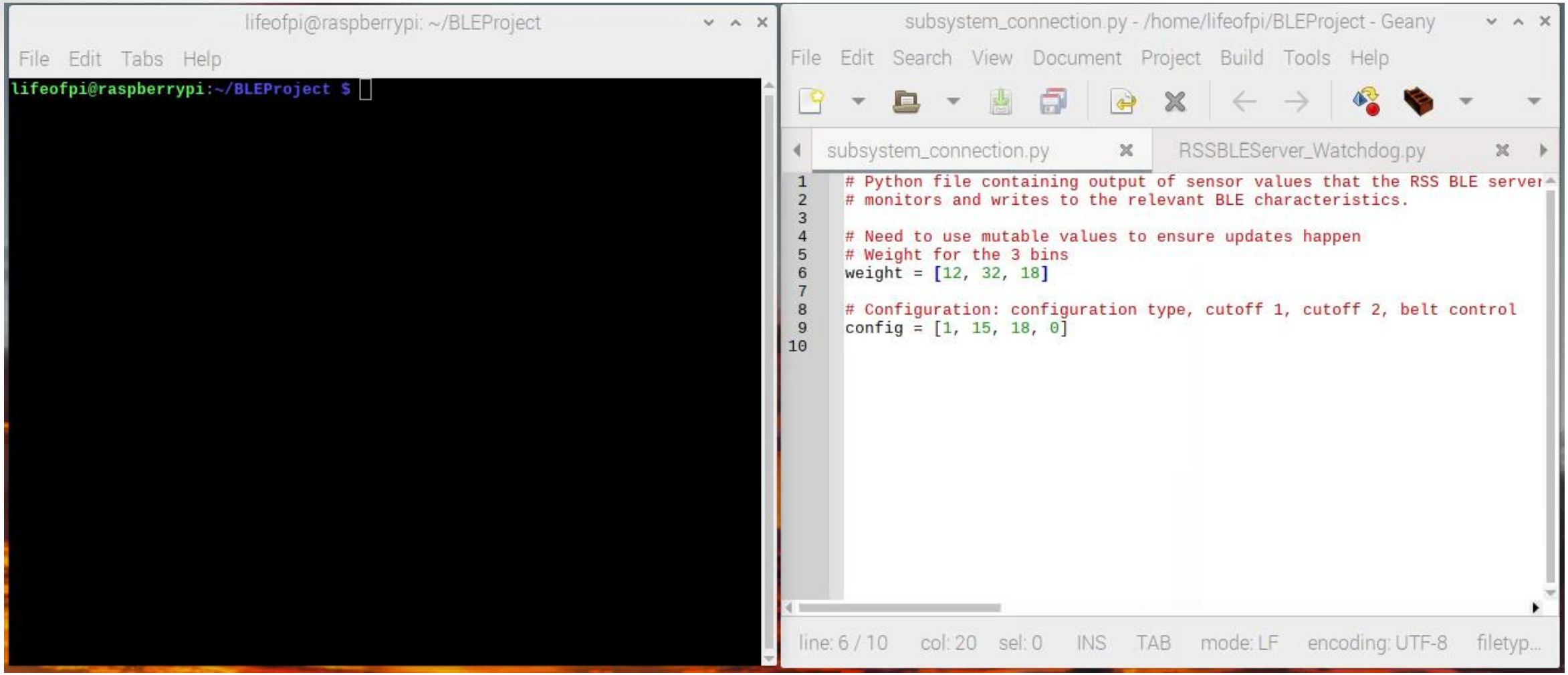
Project Timeline

Finished Android Application subsystem (completed 2/5)	Finished 403 Sensor subsystem (completed 2/19)	Power Control System (to complete by 3/12)	Final Integration of Android App connection (to complete by 3/12)	Finish basic Robotic Sorting System functionality (to complete by 3/12)	All subsystems integrated (to complete by 4/9)	Final Project Demonstration (to complete by 4/24)

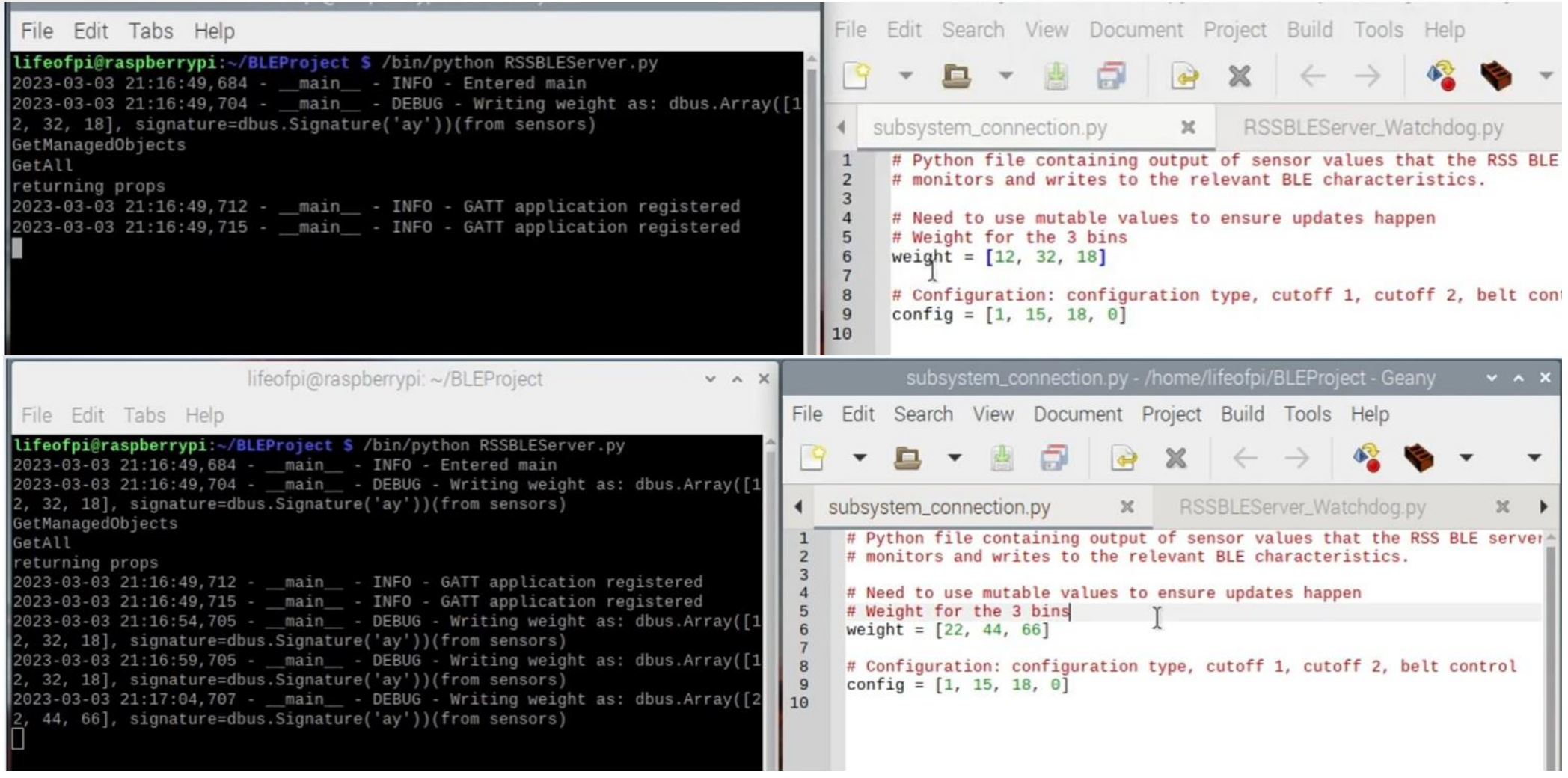
Joseph Miller

Accomplishments since Status Update 3 (12 hours of effort)	Ongoing progress/problems and plans until the next presentation
● Bluetooth server now successfully detects changes in the “subsystem connection” file	● Continue to help with other parts of the project ● Begin specific (using validation plan methods) testing of Android app / Bluetooth connection with other components as soon as they are available ○ Conveyor belt: Start/stop belt from application ○ Robotic guiding arm: Ensure that configuration information can be read from connecting file ○ Sensors: Ensure that weight information can be written to connecting file

Bluetooth Server Integration with Subsystem Connection on Raspberry Pi



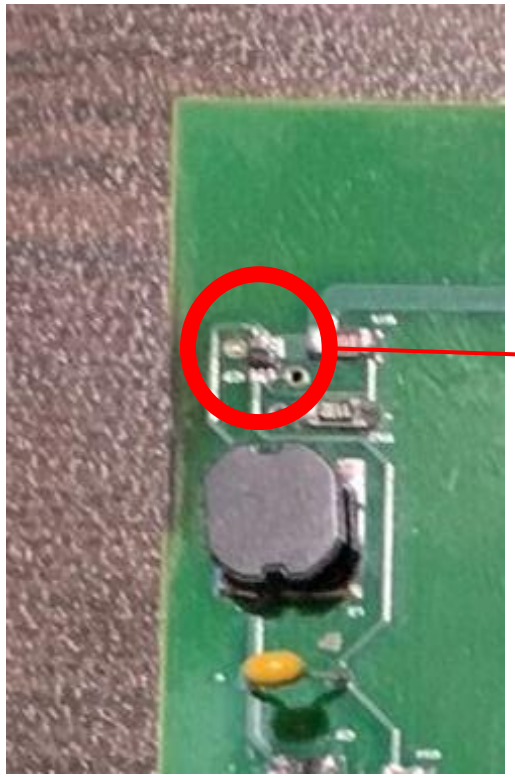
Bluetooth Server Integration with Subsystem Connection on Raspberry Pi

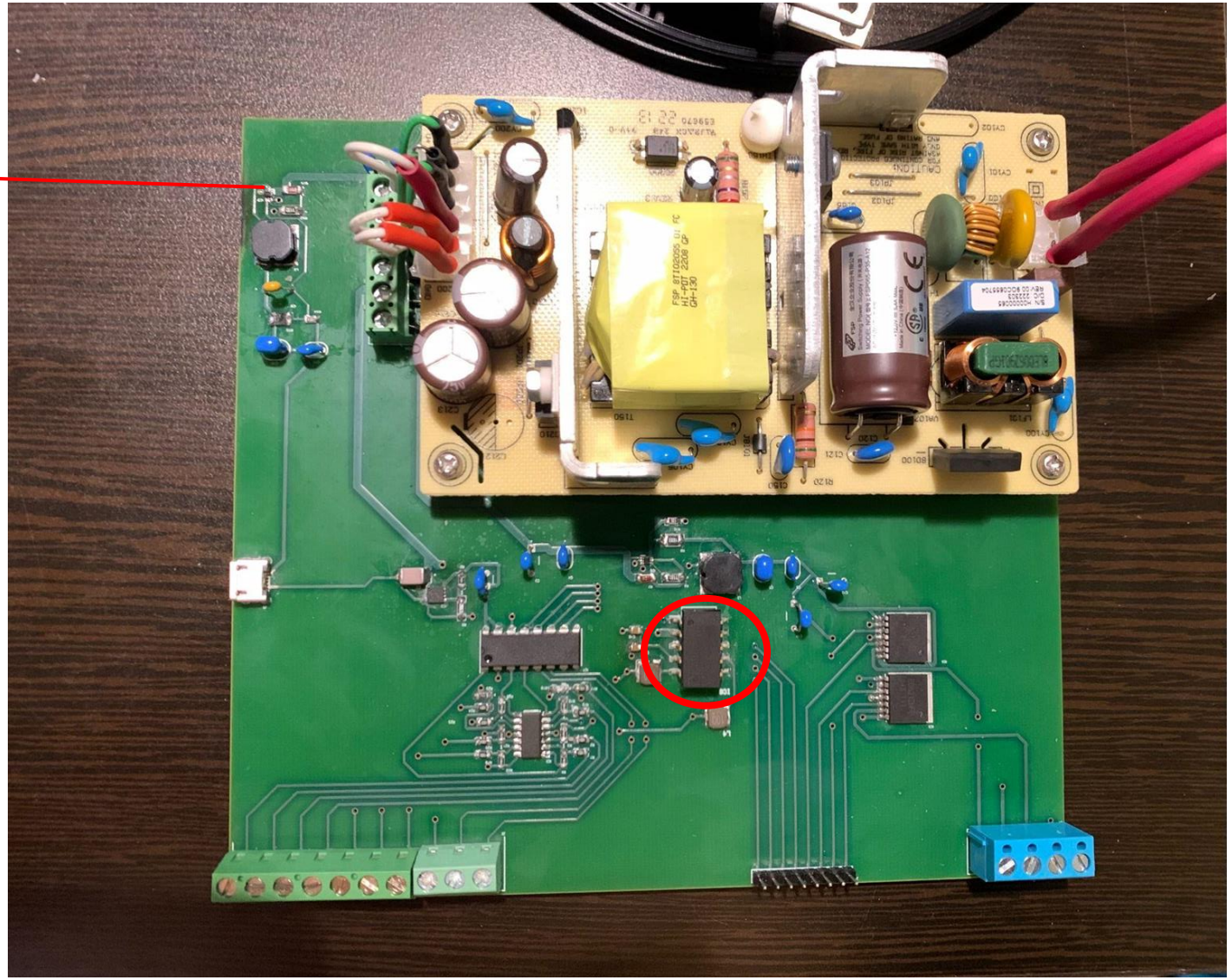


Pace Dominy

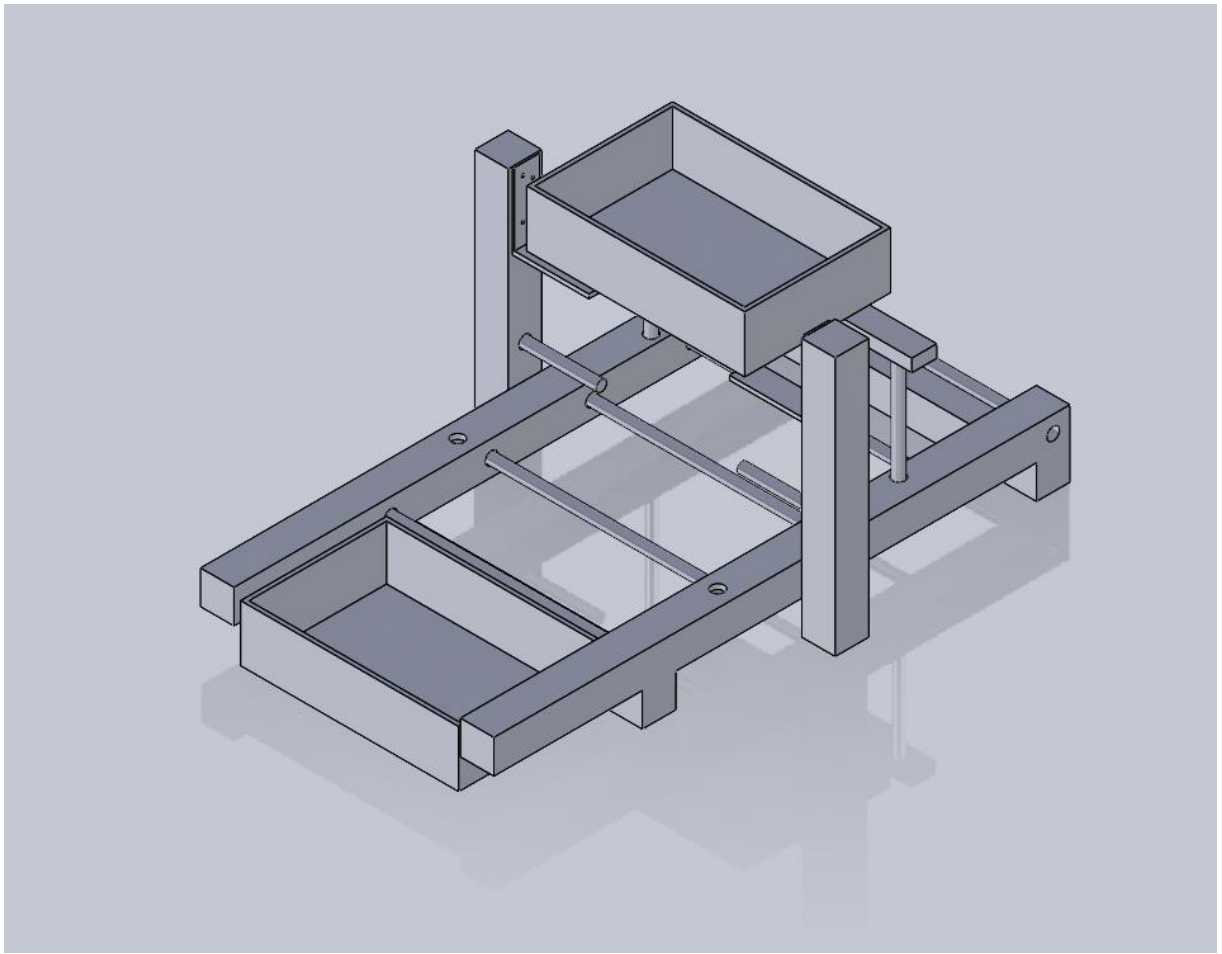
Accomplishments since Status Update 2 (23 Hours of Effort)	Ongoing progress/problems and plans until the next presentation
• Validated PCB with external power supply • Connected PSU to PCB • Tested motor controller functionality on PCB with python code • 3D printed motor controller connectors and ensured low compliance • Tested integration with load cells • Built frame of conveyor belt	• Replace destroyed components from PSU connection mistake • Finish building conveyor belt and guiding rails • Write python code for guiding rail orientations and conveyor belt start/stop • Integrate PCB with conveyor belt and guiding rails

Finished PCB





Conveyor Belt



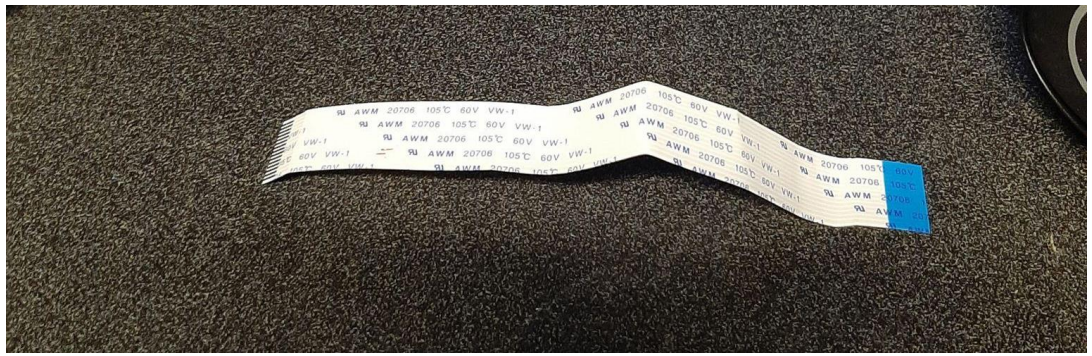
Lam Tran

Accomplishments since Status Update 3 (33 hrs of effort)	Ongoing progress/problems and plans until the next presentation
• Experienced some issues • Resolved these issues • Labeled some images • Trained a model with these labeled images • Test a model to detect lemons	• Integrating sensor subsystem with other subsystem • Labeling the data images to include defects • Training the model with new labeled images • Test the model with fruits (lemons) to check if it could detect defects.

Issues that occured


```
(tflite) lifeofpi@raspberrypi:~/examples/lite/examples/object_detection/raspberr
Traceback (most recent call last):
  File "/home/lifeofpi/examples/lite/examples/object_detection/raspberry_pi/dete
    from picamera2 import Picamera2, Preview
ModuleNotFoundError: No module named 'picamera2'
```

```
(base) C:\Users\lam12\OneDrive\Desktop\labelImg-master\labelImg-master>python labelImg.py C:\User
C:\Users\lam12\OneDrive\Desktop\labelImg-master\labelImg-master\labelImg.py:213: DeprecationWarni
s using __int__ is deprecated, and may be removed in a future version of Python.
  self.dock.setFeatures(self.dock.features() ^ self.dock_features)
Traceback (most recent call last):
  File "C:\Users\lam12\OneDrive\Desktop\labelImg-master\labelImg-master\labelImg.py", line 1374,
    self.open_next_image()
  File "C:\Users\lam12\OneDrive\Desktop\labelImg-master\labelImg-master\labelImg.py", line 1429,
    self.change_save_dir_dialog()
  File "C:\Users\lam12\OneDrive\Desktop\labelImg-master\labelImg-master\labelImg.py", line 1309,
    self.show_bounding_box_from_annotation_file(self.file_path)
  File "C:\Users\lam12\OneDrive\Desktop\labelImg-master\labelImg-master\labelImg.py", line 1182,
    basename = os.path.basename(os.path.splitext(file_path)[0])
  File "C:\Users\lam12\anaconda3\lib\ntpath.py", line 204, in splitext
    p = os.fspath(p)
TypeError: expected str, bytes or os.PathLike object, not NoneType
```


AWM 20706 105℃ 60V VW-1

Issue resolved

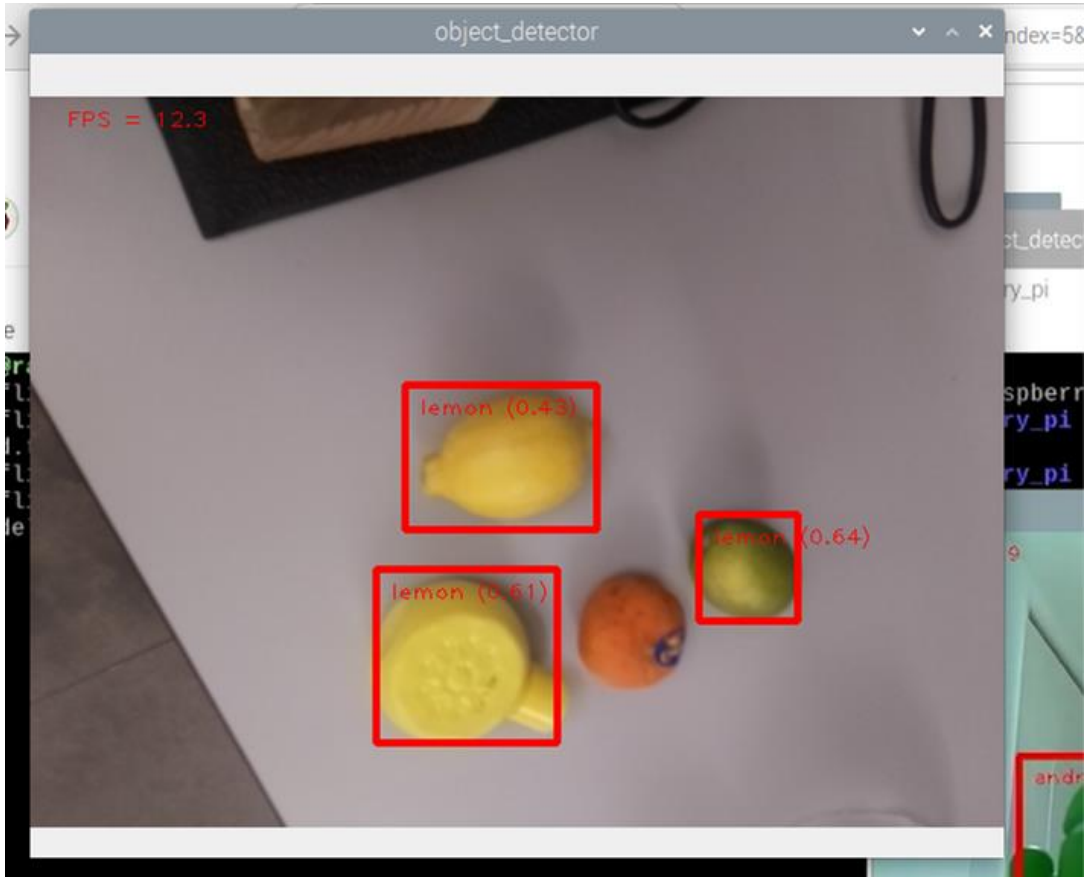
```
5
6  cap = cv2.VideoCapture(0)
7  cap.set(cv2.CAP_PROP_FRAME_WIDTH,1280) #<--
8  cap.set(cv2.CAP_PROP_FRAME_HEIGHT,720) #<--
9  # Capture frame
```

```
lifeofpi@raspberrypi:~/examples/lite/examples/object_detection/raspberry_pi $ py
thon detect.py --model android.tflite
INFO: Created TensorFlow Lite XNNPACK delegate for CPU.
```

```
213        self.dock.setFeatures(self.dock.features() ^ int(self.dock_features))
```

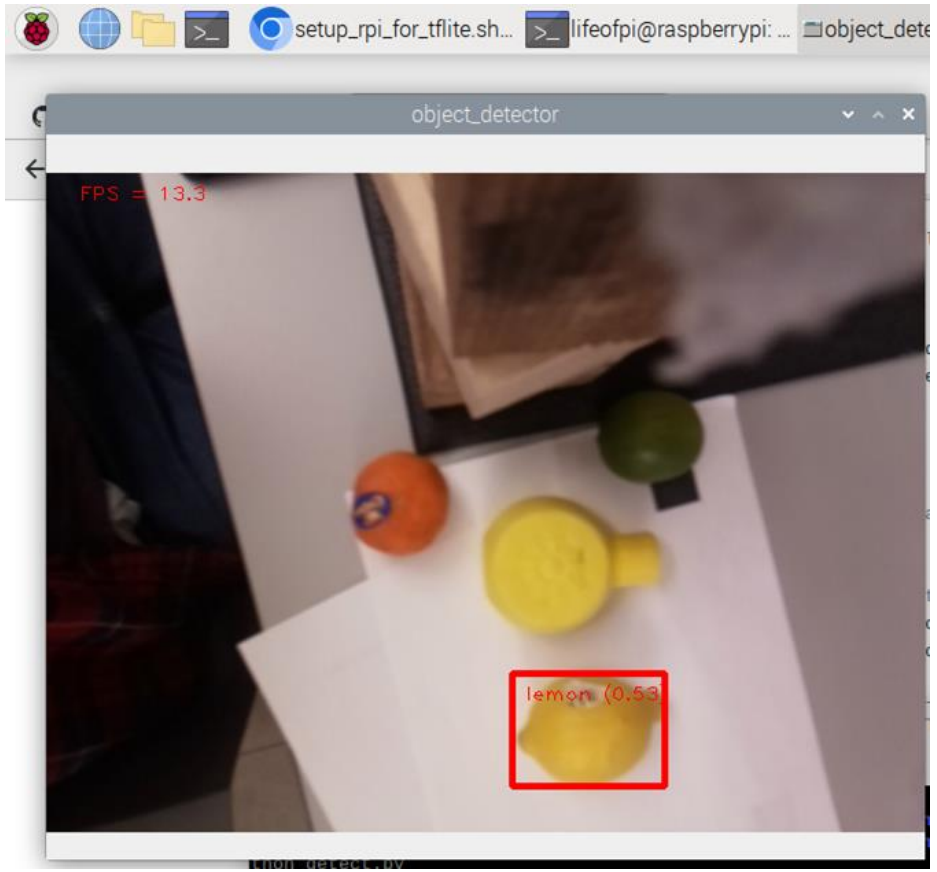
```
1309        self.show_bounding_box_from_annotation_file(str(self.file_path))
```

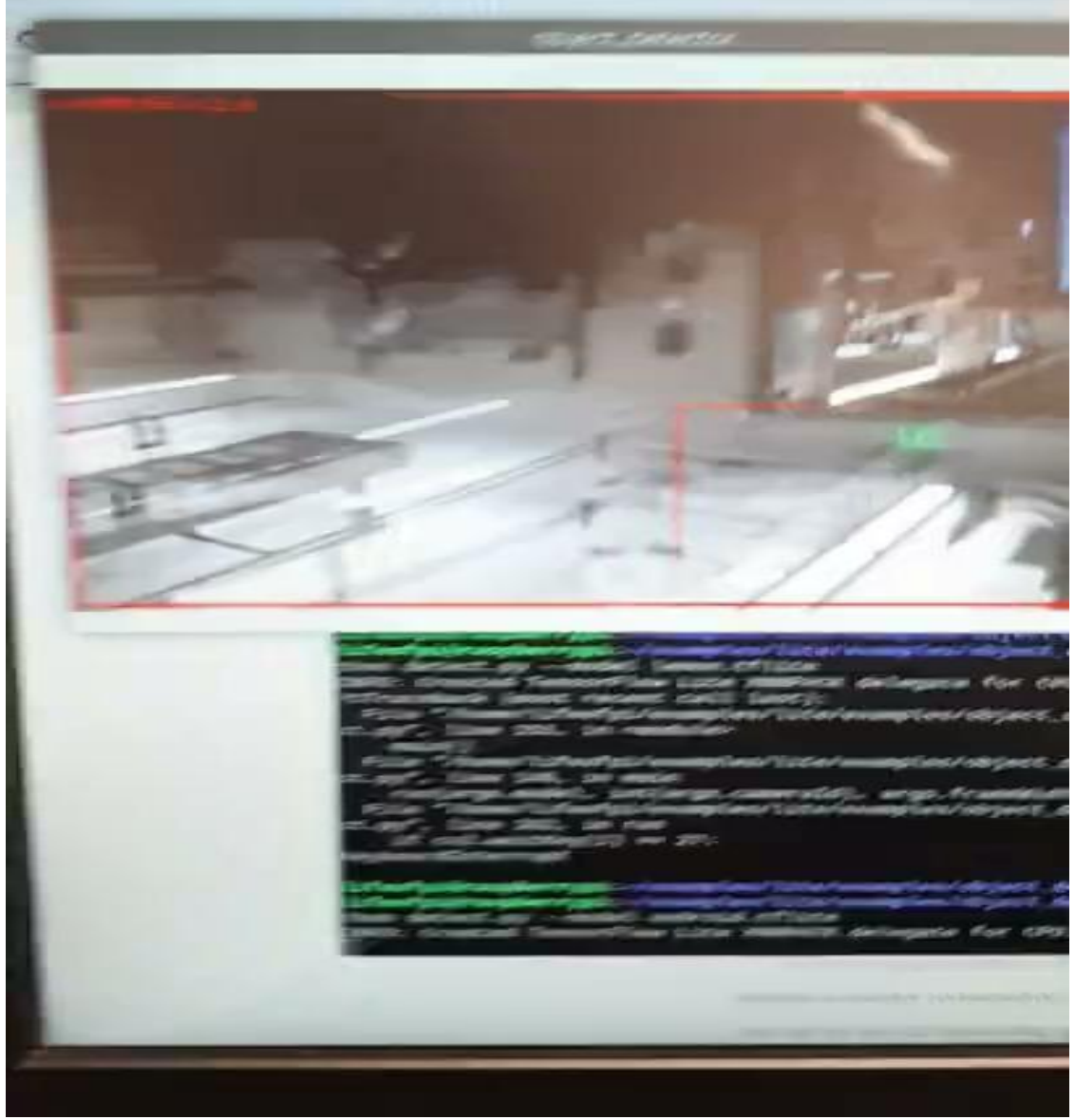
Progress on Machine Learning Model

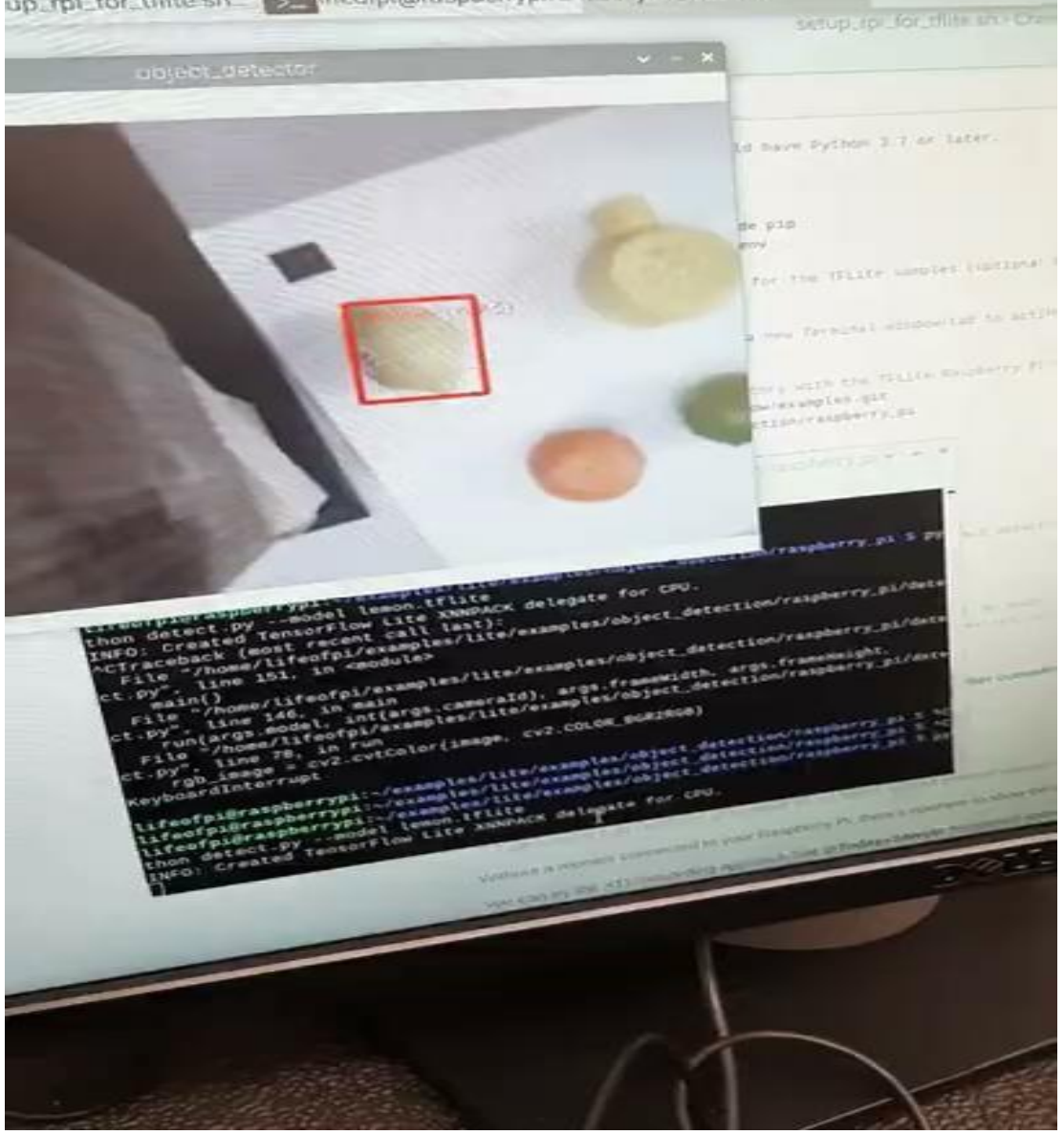



lifeofpi@raspberrypi:
[Train a custom obje...
File Edit View Sort Go Tools
ML


LEGION
Lenovo


setup_rpi_for_tflite.sh...
lifeofpi@raspberrypi: ...
object_dete
object_detector
FPS = 13.3
lemon (0.53




object_detector
thon detect.py --model lemon.tflite
INFO: Created TensorFlow Lite XNNPACK delegate for CPU.
^CTraceback (most recent call last):
File "/home/lifeofpi/examples/lite/examples/object_detection/raspberry_pi/det
ct.py", line 151, in <module>
main()
File "/home/lifeofpi/examples/lite/examples/object_detection/raspberry_pi/det
ct.py", line 146, in main
run(args.model, int(args.cameraId), args.frameWidth, args.frameHeight,
File "/home/lifeofpi/examples/lite/examples/object_detection/raspberry_pi/det
ct.py", line 78, in run
rgb_image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
KeyboardInterrupt
lifeofpi@raspberrypi:~/examples/lite/examples/object_detection/raspberry_pi $ py
lifeofpi@raspberrypi:~/examples/lite/examples/object_detection/raspberry_pi $ py
thon detect.py --model lemon.tflite
INFO: Created TensorFlow Lite XNNPACK delegate for CPU.

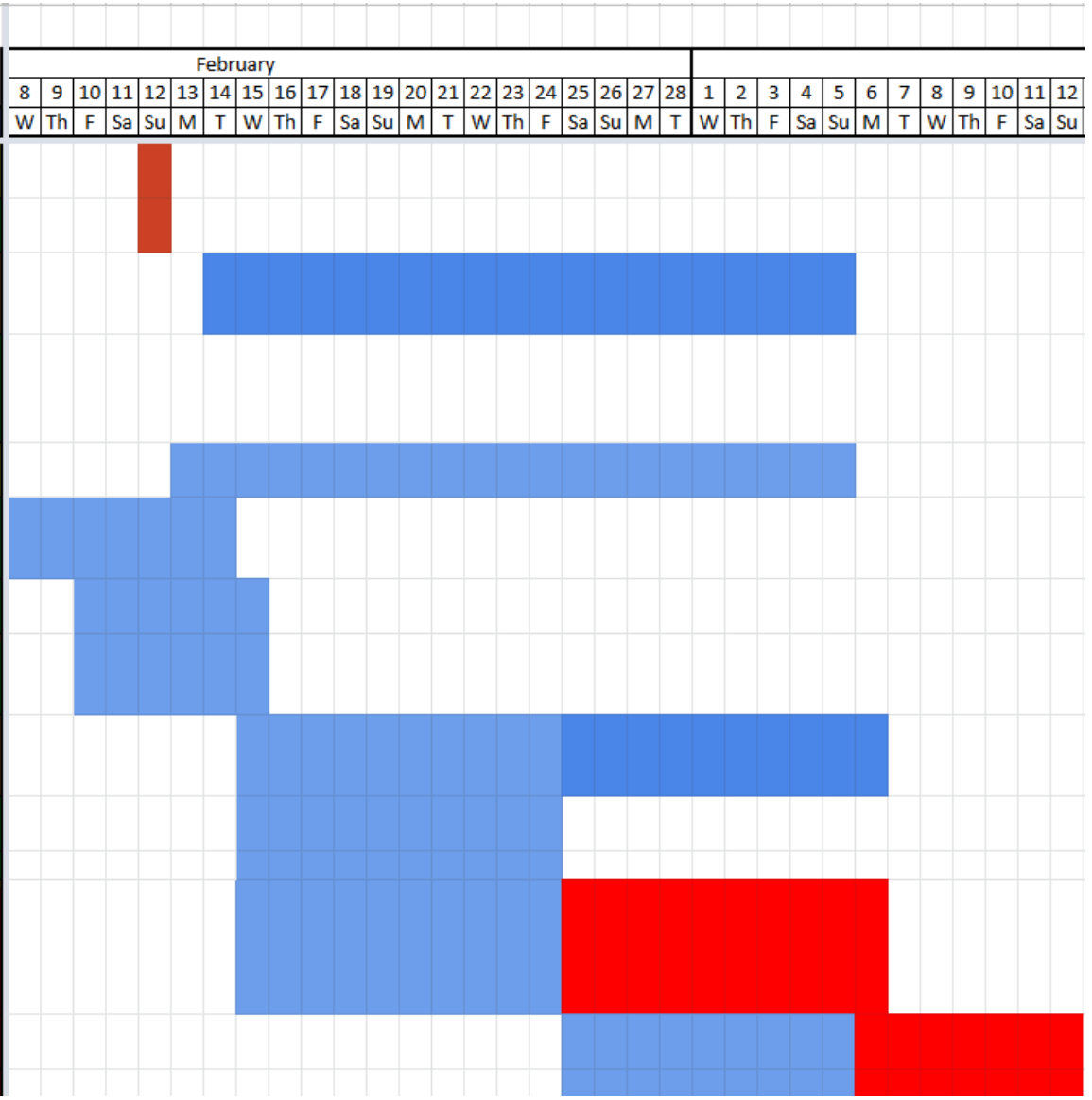
Execution Plan: Recent Progress

Robotic Sorting System

ECEN 403/404-901

Pace Dominy, Joseph Miller, Lam Tran

Event Description	Assigned to	Progress
Finish power control subsystem	**Pace**	
Finish sensor subsystem	**Lam**	
Implement fruit's scarring/disfigurement detection	Lam	
Install Bluetooth server setup on RSS RPi and test basic functionality	Joseph	
Build Conveyor Belt & Lever Arms	Pace	
Pass sensor data to Bluetooth server on Raspberry Pi	Joseph	
Test weight sensor code with 3 load cell	Lam	
Pass configuration information to robotic arms	Joseph	
Find/Collect dataset for machine learning model	Lam	
Find model/type for model	Lam	
Set up ML enviroment	Lam	
Functional test of Android application connections with sensor and robotic arms	Joseph	
Validate Conveyor Belt	Pace	
Validate Lever Arm	Pace	



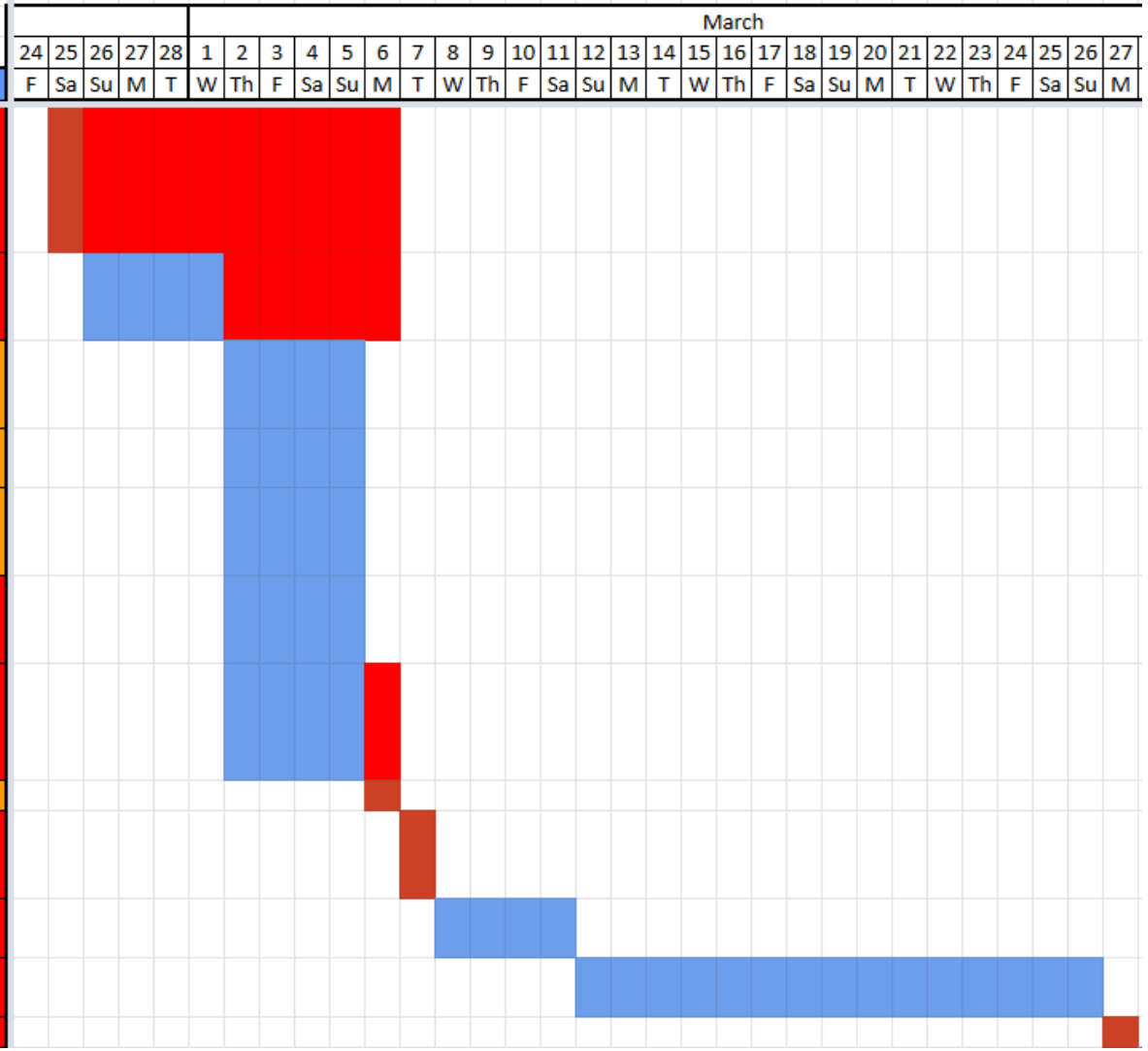
Execution Plan: Upcoming Plans

Robotic Sorting System

ECEN 403/404-901

Pace Dominy, Joseph Miller, Lam Tran

Event Description	Assigned to	Progress
Finalize integration of Android app connections (with robotic arms and sensors)	**Joseph**	
Range and error testing for app/sensor interface	Joseph	
Finished building the machine learning model	Lam	
Train the model with the dataset	Lam	
Intergate the machine learning model to the Raspberry Pi	Lam	
Test and Validate the machine learning model	Lam	
Range and error testing for app/robotic arm interface	Joseph	
Status Update 4	**All**	
Finish basic Robotic Sorting System functionality	**All**	
Develop and assign test scenarios	All	
Execute and debug test scenarios	All	
Status Update 5	**All**	



Validation Plan (part 1)

ECEN 403 (Subsystem)					
Subsystem	*Test Name*	*FSR Reference*	*Success Criteria*	*Status*	*Responsibility*
App	Boot Functionality	Subsystem 3.1, 3.2.1	A skeleton version of the app (few to no features) successfully boots on a physical Android device and does not crash.	Complete: app boots properly	Joseph
App	Specification Sorting	Subsystem 3.2.4.1.1	The app successfully allows the user to configure and store two "bin conditions". Attempting to set a value outside of the sensors' abilities returns an error.	Complete	Joseph
App	Bluetooth Connection	Subsystem 3.2.4.2	An Android device successfully connects to the Bluetooth-enabled microcontroller.	Complete: connection successfully made and maintained for 2', disconnect and reconnect successfully completed	Joseph
App	Bluetooth Configuration	Subsystem 3.2.4.1.1, 3.2.4.2	The app succesfully passes a sorting configuration to the microcontroller.	Complete	Joseph
Power	PCB Voltages	Subsystem 3.2.3.1	Input power is correct (120V at 15A), conveyor belt & guidng arms respective motor drivers receive correct voltage, ADC receives correct voltage, RasPi recevies correct voltage. Test efficiency and noise of all 4 buck converters.	Partially-Complete: PSU connected and PCB receives correct voltages to motor controller and to ADC. All buck converters were tested before PSU was connected. Initially, PSU was connected incorrectly and a couple components on the board were "fried".	Pace
Power	Raspbery Pi Power	Subsystem 3.2.3	Validate Raspberry Pi receives correct voltage and turns on. Also validate that raspberry pi camera turns on.	Partially-Complete: Circuit works with external power supply. PSU fried component so it needs to be replaced and tested with PSU.	Pace
Weight sensor	Weight measurement Validation	Subsystem 3.1, 3.2.1.1	Validate weight sensor is connected to the Raspberry Pi. Validate that the weight measurement is display. Validate that the measurement is accurate with a few degree of error.	Semi-complete(need to calibration the sensor with a solid frame so it displayed the weight in kilograms or pounds)	Lam
Color sensor	Color sensing Validation	Subsystem 3.1, 3.2.1.3, 3.2.2.1	Validate that the camera(s) is connected to the Raspberry Pi. Validate that the hue value is display. Validate that the hue value match with the color.	complete	Lam
Size sensor	Size Measurement Validation	Subsystem 3.1, 3.2.1.3, 3.2.2.1	Validate that the camera(s) is connected to the Raspberry Pi. Validate that the size measurement is display. Validate that the size measurement is accurate with a few degree of error.	complete	Lam

Validation Plan (part 2)

ECEN 404 (Integration/Project)					
Subsystem	*Test Name*	*FSR Reference*	*Success Criteria*	*Status*	*Responsibility*
App	Basic write test	Subsystem 3.2.4.1.1 Project 3.2.3.1	A configuration value chosen by the user using the Android application will be written to the Bluetooth server. That value can then be read by the Android app.	Complete: wrote 6, then read 6 in the Diagnostics screen	Joseph
App	Basic read test	Subsystem 3.2.4.1.2 Project 3.2.3.4	The application will read the configuration and weight values from the Bluetooth server and display those values on the Diagnostics and Machine Information screen.	Complete: read 56 for weight and 12 for configuration	Joseph
App	RSS RPi integration test	Subsystem 3.2.4.1.1, 3.2.4.1.2 Project 3.2.3.1, 3.2.3.4	The results from the Basic Write Test and Basic Read Test will be successfully replicated on the RSS Raspberry Pi.	Complete	Joseph
App	Faulty configuration protection	Subsystem 3.2.3.1, 3.2.5 Project 3.2.5	The faulty configuration values 30, 0, and -1 will not be written to the Bluetooth server and will result in a popup error.	Complete	Joseph
Sensor	Intergating the sensors with the RPI and the RasPiCam	Subsystem 3.2.2.3, 3.2.2.4	The Raspberry Pi is able to use the RasPiCam to take a image, and use it to determine the size or color of the fruit.	Complete	Lam
Sensor	Fruit's scarring/disfigure ment detection	ConOp 4.3 Subsystem 3.2.2.4.3	The Raspberry Pi is able to tell if the fruit have some scarrings or disfigurements. This will determines whether or not the fruit is fit to be sold to the market.	Partially complete: Right now the model is able to detect lemon. The defects of the lemon need to be label and a model have to be trained with these labels.	Lam
Lever Arm	Position Validation	Subsystem 3.2.1	Lever arm moves to correct position based off of the data from the sensors	Incomplete	Pace
App/Sensors	App/Sensor Integration	App Subsystem 3.2.1.4.2 Project 3.2.3.4	The weight value passed from the sensor to the Raspberry Pi is shown on the Diagnostic screen of the Android app.	Partially complete: Bluetooth server weight characteristic is exposed to sensor subsystem and will update when the sensor changes it.	Joseph/Lam
App/Lever Arm	App/Lever Arm Integration	App Subsystem 3.2.4.1.1 Project 3.2.3.1 Robotic Arm Subsystem 3.2.1.2	The robotic arm moves to Bin 1 based on the configuration passed in via the Sort by Size screen.	Partially complete: configuration information from Bluetooth server is exposed to robotic arm system.	Joseph/Pace
Lever Arm & Conveyor Belt	Timing Validation	Subsystem 3.2.1	Lever arm moves to correct position and stays there. Conveyor belt then turns on and lever arm does not move until it is required to do so again	Incomplete	Pace
Lever Arm/Sensors	Lever Arm/Sensors Intergration	Project 3.2.3.4.3, Sensor Subsystem 3.2.2.4.1	Lever arm moves a certain the position based off of the sensor output.	Incomplete	Pace/Lam
Converyor Belt/Sensors	Converyor Belt/Sensors Integration	Project 3.2.2.2, Sensor Subsystem 3.2.2.1	The camera is postion to take clear and consistent images. The weight sensor will be calibrated when it is attact to converory belt system and holding the bins.	Incomplete	Pace/Lam
App/Conveyor Belt	Belt Start/Stop	Project 3.2.3.1	The app passes a command to stop and start the belt.	App subsystem-complete (app sends belt start/stop bit)	Joseph
App/Sensors	Sensor Error Testing	Project 3.2.5.1.3	The sensor indicates a fault, causing an error message on the Diagnostic screen.	Incomplete	Joseph/Lam
App/Conveyor Belt	Belt Movement Error	Project 3.2.5.1.1, 3.2.5.1.2	The app returns an error if the belt is obstructed or the power to the machine is cut off (stopping the belt).	Incomplete	Joseph
App/System	Full Functionality	App Subsystem: All Project: 3.2.1.4, 3.2.3.1, 3.2.3.4.1, 3.2.3.4.2, 3.2.5	The app passes a configuration to the machine and starts the belt. When sorting is complete, the app stops the belt and returns a notification.	Subsystem-complete (need to build RSS to connect to)	Joseph

Thank you!