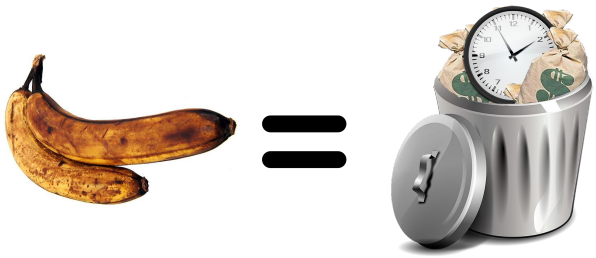
TEAM B3: FARMFRESH

Ishita Kumar, Ishita Sinha, Kushagra Sharma

Application Area

- Millions of $$ wasted yearly packaging and transporting rotten fruit
- Manual labor and time of farmers separating rotten fruit.



FarmFresh: Solution Approach

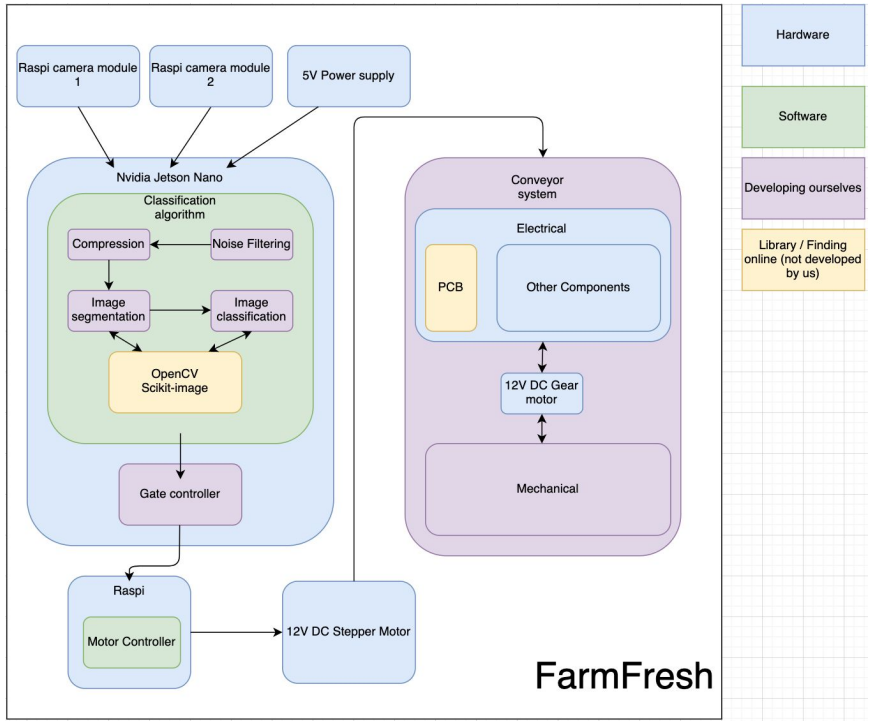
FarmFresh
- An AI tool to sort and mechanically separate rotten fruit and fresh fruit.
- Works on multiple fruits: bananas, apples, and oranges.

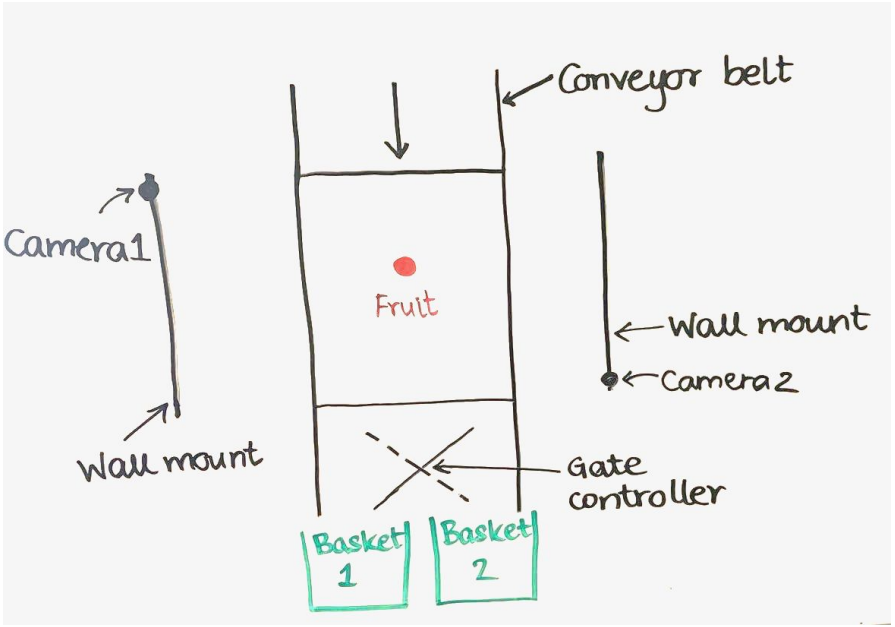
Existing Solution
- TOMRA has multiple machines for sorting foods
- Usually very expensive ($ 10,000 - $ 25,000)
- Not feasible on small scale, which is our target market.

Blizzard sorting machine by TOMRA

Our Solution
- Cheaper
- Multi-fruit

System Specification: Diagrams





System Specification: Design Overview

- Hardware platforms: Raspberry Pi, NVIDIA Jetson Nano 2GB
- RPi camera V2 and USB Camera
- Stepper motor and gate (to direct fruits in right basket)
- Conveyor belt parts and motor
- 2 baskets (for collecting rotten/good fruit)
- Light to control brightness
- Wall mounts/shed for placing camera and Nano
- 6600 mAh Li-on battery
- Dataset: Google images, manual pictures
- Libraries: Scikit-image, OpenCV

Implementation: Software + Hardware

Software

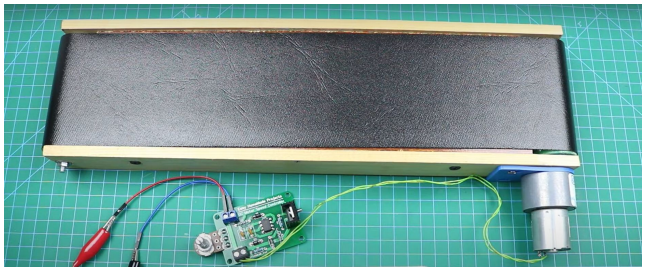
- Using cv2 library for image segmentation
- Using cv2 library for object detection for fruits
- Color analysis by pixels to detect rottenness
- Train model to classify fresh vs. rotten fruits using scikit-learn
- Dataset: Google images and manual pictures
- Program gate motor for sorting mechanism

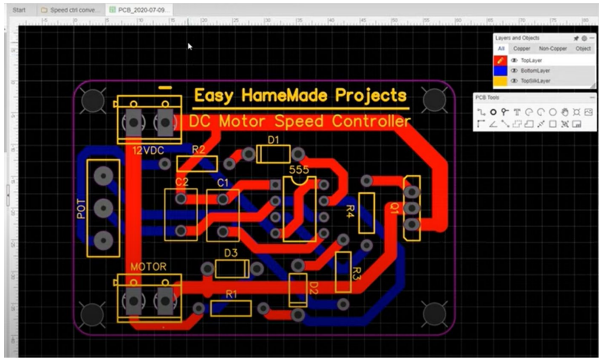
Hardware

- Ordered Jetson Nano and the camera modules
- Download jetpack sdk and sd card image
- Program cameras to take pictures every 4s and save on disk
- Send signal to gate controller motor for sorting mechanism

Implementation - Mechanical

Mechanical components of Building a Conveyor Belt:





Metrics and Validation

Requirements	Metrics	Verification
Easy to install	Should work with existing belt infrastructure	Test with the conveyor belt system we built.
Meet the conveyor belt speed	Be able to take picture every 4 s. Gate should fire before fruit passes through it	Simulate the process by putting new fruits quickly. No deadline should be missed.
Accuracy	False Negatives < 5% False Positives < 15%	Run a test with 50 fruits. Should meet classification metrics.
Battery life	Battery should last 8 hours (typical working day)	Run the setup (camera + gate system) until battery runs out.
Fruit spacing	Handle fruits spaced at a distance of 20 cm ± 5 cm.	Test the extremes (25 cm and 15 cm). No deadlines should be missed.
No fruit should be missed	No fruit should be missed	Perform a stress test with 50 fruits.

Risk assessment

Metric / Design	Risk	Mitigation
Building a conveyor belt	None of us have ever built anything mechanical. Possible we can't build it	If we can't build the conveyor belt, use a treadmill to simulate the process.
Meet the conveyor belt speed	Possible we miss taking pictures of fruits if speed is too high, or classify same fruit twice if speed too low	Experiment with different speeds, since we are building a variable speed conveyor belt.
Accuracy	False Negatives < 5% False Positives < 15%	Design multiple classification algorithms. Don't rely on one one software approach.
Integration	Not able to integrate different parts (hardware, software, mechanical) before time runs out	Leave time in gantt chart for integration. Update schedule regularly and hold teammates accountable.

Tasks and Division of Labor

Ishita Kumar

- Image segmentation
- Object classification
- Rotten fruit classification
- Train and test models
- Automate picture taking
- Building the physical setup

Ishita Sinha

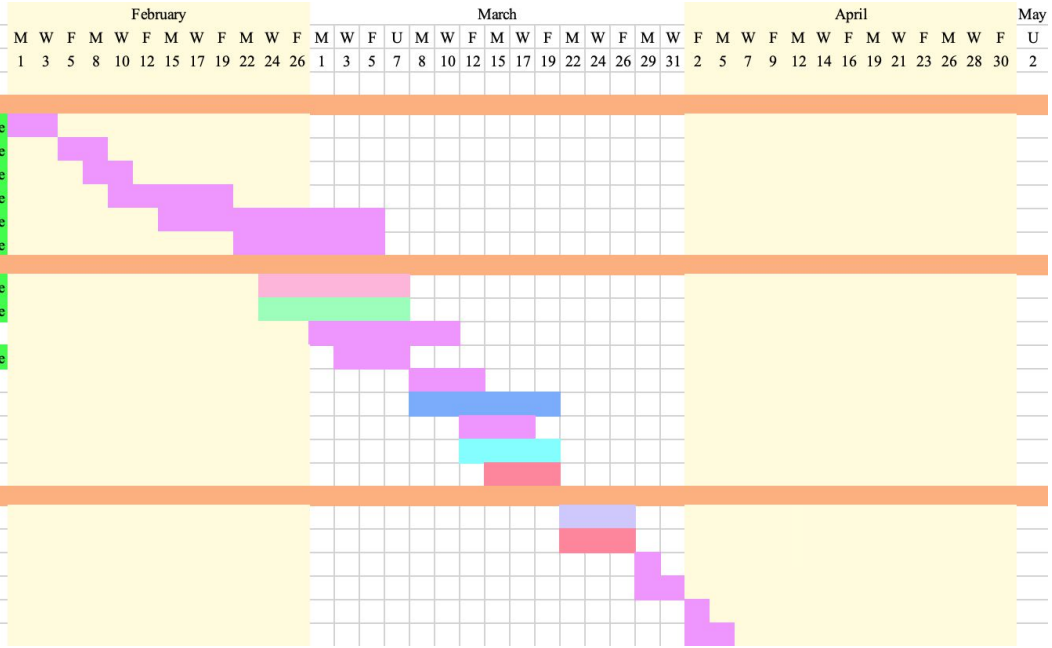
- Color analysis by pixels
- Rotten fruit classification
- Train and test models
- Programming Jetson Nano
- Raspberry Pi + gate
- Building the physical setup

Kushagra Sharma

- Programming Jetson Nano
- Automate picture taking
- Raspberry Pi + gate
- Building the physical setup

Schedule

	FarmFresh	Ishita K.	Ishita K. + Ishita S.		Everyone	
		Ishita S.	Ishita S. + Kush			
		Kush	Ishita K. + Kush			
	Tasks	**Due Date**	**Start**	**End**	**Team Member**	**Status**
1	**Phase 1: Project Proposal and Planning**					
1.1	Research different project ideas				Everyone	Complete
1.2	Finalise project idea				Everyone	Complete
1.3	Project abstract	02/10			Everyone	Complete
1.4	Proposal presentation	02/21			Everyone	Complete
1.5	Finalise product design				Everyone	Complete
1.6	Finalise parts list				Everyone	Complete
2	**Phase 2: Design and Implementation**					
2.1	Work on image segmentation and object classification				Ishita K.	Complete
2.2	Work on color analysis				Ishita S.	Complete
2.3	Order hardware components				Everyone	
2.4	Design presentation	03/07			Everyone	Complete
2.5	Click pictures for the actual dataset				Everyone	
2.6	Train and test the rottenness predictor				Ishita K. + Ishita S.	
2.7	Design review report	03/17			Everyone	
2.8	Preliminary physical set-up for product				Kush	
2.9	Jetson Nano setup				Ishita S. + Kush	
3	**Phase 3: Testing and Integration for MVP**					
3.1	Automate picture taking				Ishita K. + Kush	
3.2	Automate gate rotation using Raspberry Pi				Ishita S. + Kush	
3.3	Integration test				Everyone	
3.4	Fix issues post integration test				Everyone	
3.5	Performance test				Everyone	
3.6	Fix issues post performance test				Everyone	



Schedule

FarmFresh		Ishita K.	Ishita K. + Ishita S.		Everyone	
		Ishita S.	Ishita S. + Kush			
		Kush	Ishita K. + Kush			
	Tasks	Due Date	Start	End	Team Member	Status
4	**Phase 4: Final Product**					
4.1	Update model to include apples and oranges				Ishita K. + Ishita S.	
4.2	Final all-inclusive test #1				Everyone	
4.3	Fix issues post final all-inclusive test #1				Everyone	
4.4	Final all-inclusive test #2				Everyone	
4.5	Fix issues post final all-inclusive test #2				Everyone	
5	**Phase 5: Final Report**					
5.1	Record video				Everyone	
5.2	Edit video				Everyone	
5.3	Final report				Everyone	
5.4	Final presentation	05/02			Everyone	

Month	Days
February	M W F M W F M W F M W F
	1 3 5 8 10 12 15 17 19 22 24 26
March	M W F U M W F M W F M W F M W
	1 3 5 7 8 10 12 15 17 19 22 24 26 29 31
April	F M W F M W F M W F M W F
	2 5 7 9 12 14 16 19 21 23 26 28 30
May	U
	2