
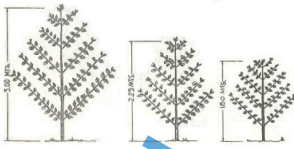










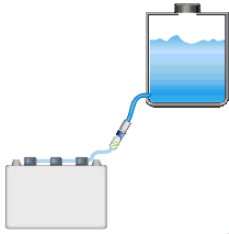


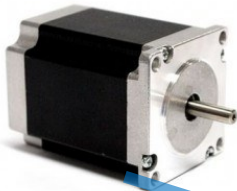








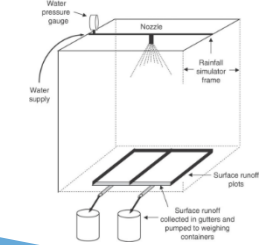








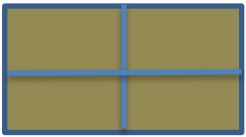
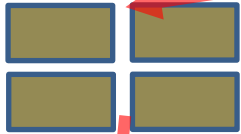
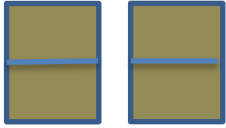










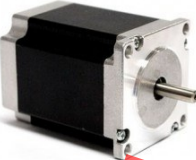





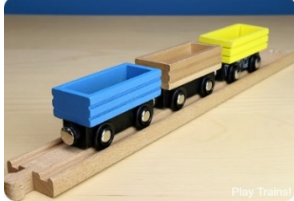



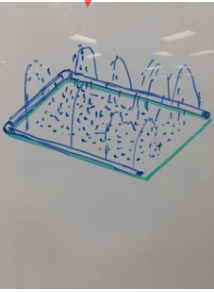







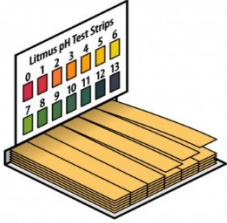

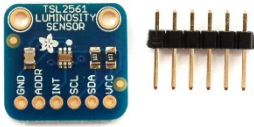


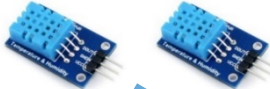




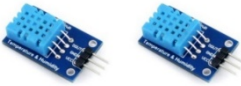



Table S1. Morphological Matrix.

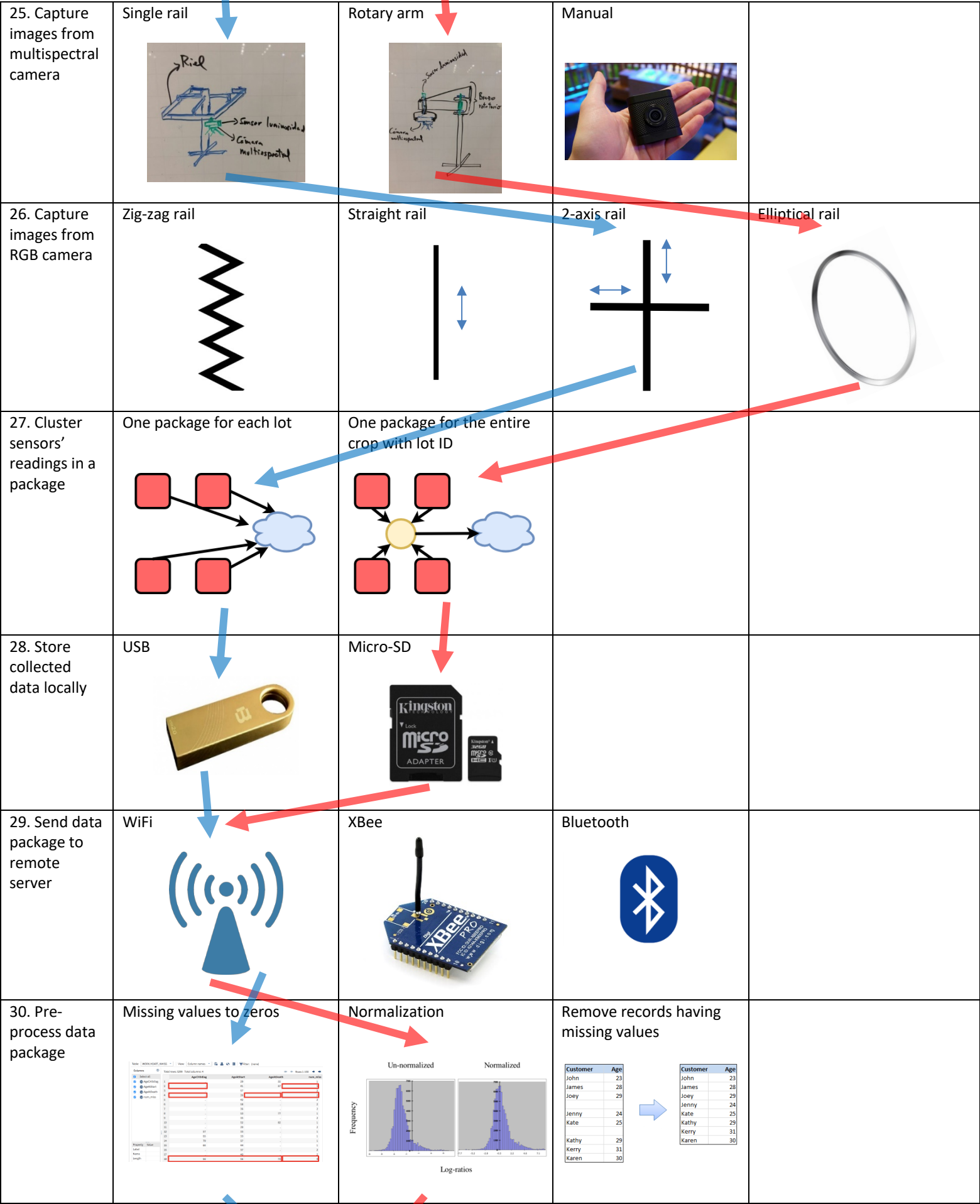
→ CONCEPT 1 → CONCEPT 2



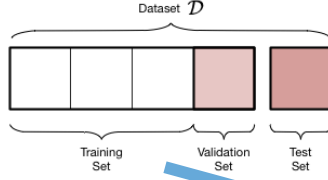
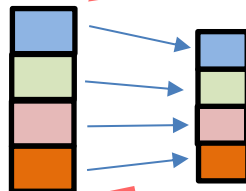
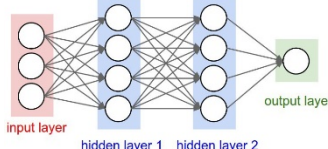
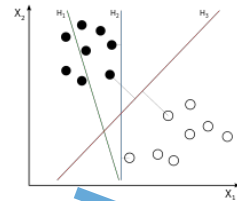
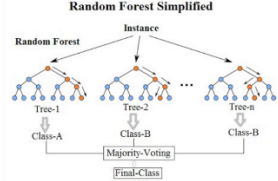
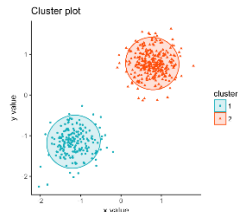
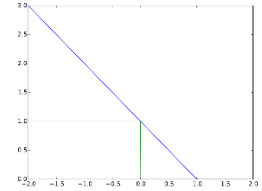
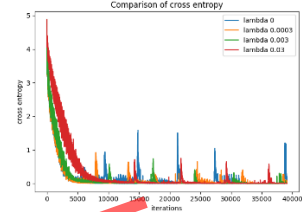
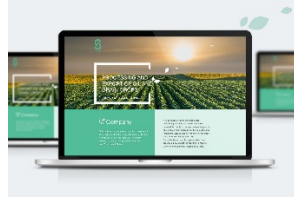



FUNCTION CARRIER				
Function	PROPOSAL 1	PROPOSAL 2	PROPOSAL 3	PROPOSAL 4
1. Group coffee plants	<p>"Almacigo" group</p> 	<p>Coffee group with diverse ages</p> 	<p>Coffee group in production stage</p> 	<p>Coffee plants between "almacigo" and production stage</p> 
2. Store organic matter	<p>Plant pots</p> 	<p>Plant bags</p> 	<p>Crop beds</p> 	<p>Regular crop disposal</p> 
3. Store fertilizer and fungicide	<p>Bottles</p> 	<p>Tanks</p> 	<p>Spray</p> 	
4. Transport H ₂ O	<p>Pumping</p> 	<p>Gravity from tank</p> 	<p>Normal pressure from aqueduct system</p> 	
5. Transform electrical energy	<p>DC motor</p> 	<p>Stepper motor</p> 	<p>Servomotor</p> 	
6. Combine coffee plants with organic matter	<p>Regular crop</p> 	<p>Single plant care</p> 	<p>Raised garden beds</p> 	

7. Distribute fertilizer and fungicide	Spray 	Pressurized knapsack 		
8. Simulate rain with H ₂ O	Holes in tubes 	Sprinkler bottom-up 	Sprinkler top-down 	
9. Divide coffee plants with organic matter	Wood, class IV penetration index = 9 	Acrylic 	Bricks and cement 	Plastic, polyethylene and polipropilene. 
10. Inoculate Coffee Leaf Rust	In-vitro 	Natural (wind) 	Rub with Coffee Leaf Rust 	Brush 
11. Assemble inoculated and non-inoculated coffee plants	One single piece divided 	Independent lots 	Pairs of lots 	
12. Incorporate fungicide and fertilizer with coffee plants	Sprinkler 	Spray 	Pressurized knapsack 	Holes in tubes 

13. Perceive wind velocity	Ultrasonic wind sensor 	Dual wind sensor 	GPRS weather station 	
14. Perceive volumetric flow rate	Flow meter 	Pluviometer 	Electromagnetic flow meter 	
15. Position multispectral camera	Stepper motor 	Servomotor 	Manual 	
16. Position RGB camera	Movement by chains 	Curved rails 	Endless screw 	Small car positioning 
17. Isolate each lot of coffee plants	Plastic curtains 	Fabric curtains 	Blinds 	
18. Combine simulated rain with isolated lots of coffee plants	Holes in tubes raised from the lots 	Sprinkler above the lots 		

19. Integrate expert info with isolated lots of coffee plants	Remote monitoring 	Visual inspection 		
20. Perceive pH in isolated lots of coffee plants	Type drainage 	Type soil 	Type general 	
21. Perceive lux in isolated lots of coffee plants	Lux sensor 	Digital luminosity sensor 	LDR 	
22. Perceive humidity in isolated lots of coffee plants	Soil moisture capacitive sensor 	DHT-33 (x2) 	SHT-10 humidity sensor 	5TE / DHT-33 
23. Perceive temperature in isolated lots of coffee plants	Type soil 	Thermometer 	DHT-33 (x2) 	5TE / DHT-33 
24. Perceive electrical conductivity in isolated lots of coffee plants	Conductivity electrode 	5TE 		



31. Store pre-processed data package	Remote database 	Local database on the remote server 		
32. Divide data into training, validation and test sets	Random division 	Balance across classes + Shuffle 		
33. Process training dataset	Deep Neural Network 	Support Vector Machines 	Random forest 	Clustering 
34. Evaluate the candidate model with the validation dataset	Hinge-loss 	Cross-entropy 	Mean-Squared-Error $MSE = \frac{1}{n} \sum_{i=1}^n (y_i - \hat{y}_i)^2$	
35. Visualize the results through a simple interface using some test data	Develop a web interface 	Develop a software to automatically send e-mails 	Develop an app 	Use Thingworx PaaS 

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