**Test Data**

**Color Calibration**

Ensure the distance from the light sensor to the can is 0.6cm. We test the value of each R,G and B for a specific color of can 30 times at different positions of robot and different points on the surface of can.

Blue can:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | R | G | B |  |  |  |  |
| 1. | 52.9 | 58.8 | 58.8 | 98.55602468 | 0.536750545 | 0.596614973 | 0.596614973 |
| 2. | 64.7 | 66.7 | 51.9 | 106.4358492 | 0.607877895 | 0.626668557 | 0.487617662 |
| 3. | 5.9 | 16.7 | 42.2 | 45.76614469 | 0.128916255 | 0.364898554 | 0.92207898 |
| 4. | 15.7 | 55.9 | 50.9 | 77.21470067 | 0.203329157 | 0.723955406 | 0.659200898 |
| 5. | 33.4 | 94.2 | 45.1 | 109.650399 | 0.304604455 | 0.859094001 | 0.411307213 |
| 6. | 49.0 | 79.4 | 53.9 | 107.752355 | 0.454746442 | 0.736874846 | 0.500221086 |
| 7. | 25.5 | 73.6 | 63.8 | 100.6858977 | 0.253262876 | 0.730986182 | 0.633653783 |
| 8. | 41.2 | 77.5 | 77.5 | 117.089453 | 0.35186773 | 0.661887113 | 0.661887113 |
| 9. | 20.6 | 79.6 | 43.1 | 92.8338839 | 0.221901736 | 0.857445543 | 0.464270137 |
| 10. | 11.7 | 38.2 | 50.0 | 64.00101562 | 0.182809599 | 0.596865528 | 0.781237603 |
| 11. | 10.8 | 26.5 | 48.0 | 55.88282384 | 0.193261529 | 0.47420653 | 0.858940131 |
| 12. | 9.8 | 31.4 | 39.2 | 51.17264894 | 0.191508554 | 0.61360904 | 0.766034216 |
| 13. | 62.7 | 74.5 | 60.8 | 114.7962543 | 0.546185068 | 0.648975879 | 0.529634006 |
| 14. | 13.7 | 45.1 | 50.0 | 68.71462726 | 0.199375308 | 0.656337694 | 0.727647111 |
| 15. | 23.5 | 37.3 | 59.8 | 74.29387593 | 0.316311401 | 0.502060224 | 0.804911566 |
| 16. | 15.6 | 26.5 | 47.1 | 56.24962222 | 0.277335196 | 0.471114275 | 0.837338957 |
| 17. | 38.2 | 31.4 | 48.0 | 68.91443971 | 0.554310536 | 0.455637456 | 0.696515857 |
| 18. | 51.7 | 72.6 | 52.0 | 103.1874508 | 0.501029918 | 0.703573927 | 0.503937248 |
| 19. | 26.5 | 55.9 | 53.9 | 82.05041133 | 0.322972177 | 0.68128848 | 0.656913221 |
| 20. | 13.7 | 33.3 | 51.9 | 63.16795073 | 0.216882135 | 0.527166065 | 0.821619182 |
| 21. | 28.4 | 56.9 | 56.8 | 85.26669924 | 0.333072586 | 0.667317962 | 0.666145172 |
| 22. | 29.4 | 44.1 | 49.0 | 72.18150733 | 0.40730654 | 0.61095981 | 0.678844233 |
| 23. | 11.7 | 25.5 | 50.0 | 57.33358527 | 0.204068871 | 0.444765487 | 0.872089191 |
| 24. | 25.5 | 41.1 | 55.9 | 73.92070075 | 0.344964262 | 0.556001223 | 0.756215775 |
| 25. | 59.8 | 53.9 | 59.8 | 100.2860409 | 0.596294354 | 0.537462637 | 0.596294354 |
| 26. | 59.9 | 60.8 | 62.8 | 105.9645696 | 0.565283285 | 0.57377669 | 0.592650923 |
| 27. | 13.7 | 45.1 | 50.0 | 68.71462726 | 0.199375308 | 0.656337694 | 0.727647111 |
| 28. | 9.8 | 19.6 | 44.1 | 49.24439054 | 0.199007438 | 0.398014876 | 0.895533471 |
| 29. | 16.7 | 27.4 | 48.0 | 57.73776927 | 0.289238746 | 0.47455938 | 0.8313449 |
| 30. | 28.4 | 55.9 | 51.0 | 80.82307839 | 0.351384785 | 0.691634136 | 0.631007888 |
| Mean | 29.0 | 50.2 | 52.5 |  | 0.33517449 | 0.603336339 | 0.685645132 |
|  |  |  | Gaussian Distribution | | 0.142979122 | 0.120943592 | 0.135881179 |
|  |  |  |  | | 0.285958244 | 0.241887184 | 0.271762358 |

Green can:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | R | G | B |  |  |  |  |
| 1. | 47.0 | 89.2 | 36.3 | 107.1603005 | 0.438595261 | 0.832397815 | 0.338744851 |
| 2. | 51.9 | 111.7 | 35.3 | 128.1272414 | 0.405066084 | 0.871789627 | 0.275507375 |
| 3. | 45.1 | 120.6 | 22.5 | 130.7081482 | 0.345043524 | 0.922666274 | 0.17213923 |
| 4. | 64.8 | 79.4 | 41.2 | 110.4574126 | 0.586651439 | 0.718829077 | 0.372994433 |
| 5. | 77.5 | 85.2 | 50.0 | 125.559906 | 0.61723525 | 0.678560559 | 0.39821629 |
| 6. | 75.5 | 91.2 | 42.2 | 125.6922034 | 0.600673693 | 0.725581997 | 0.335740793 |
| 7. | 16.7 | 60.8 | 15.7 | 64.97707288 | 0.257013732 | 0.935714665 | 0.241623688 |
| 8. | 17.7 | 70.6 | 15.7 | 74.458982 | 0.237714773 | 0.948173049 | 0.210854347 |
| 9. | 63.7 | 85.3 | 32.3 | 111.2522809 | 0.572572531 | 0.766725853 | 0.290331126 |
| 10. | 69.6 | 85.3 | 33.3 | 115.0179986 | 0.605122684 | 0.741623059 | 0.289519905 |
| 11. | 69.6 | 87.3 | 37.3 | 117.714655 | 0.591260281 | 0.741623887 | 0.316867938 |
| 12. | 16.7 | 68.7 | 15.7 | 72.42285551 | 0.23059019 | 0.948595571 | 0.216782394 |
| 13. | 23.5 | 73.5 | 31.4 | 83.30942324 | 0.282080935 | 0.882253137 | 0.376908143 |
| 14. | 11.7 | 39.2 | 10.8 | 42.31040061 | 0.276527753 | 0.926486146 | 0.255256387 |
| 15. | 12.7 | 52.9 | 11.8 | 55.66812373 | 0.228137741 | 0.950274528 | 0.2119705 |
| 16. | 31.3 | 75.5 | 25.5 | 85.61652878 | 0.365583614 | 0.881839069 | 0.297839685 |
| 17. | 57.8 | 91.2 | 34.3 | 113.2906439 | 0.510192175 | 0.805009106 | 0.3027611 |
| 18. | 18.6 | 77.5 | 14.7 | 81.0450492 | 0.229501989 | 0.956258288 | 0.181380604 |
| 19. | 56.8 | 79.4 | 44.1 | 107.1233401 | 0.530229919 | 0.741201683 | 0.41167499 |
| 20. | 48.0 | 95.1 | 41.2 | 114.21668 | 0.420253854 | 0.832627949 | 0.360717892 |
| 21. | 13.7 | 43.1 | 12.8 | 47.00148934 | 0.291480125 | 0.916992219 | 0.272331796 |
| 22. | 57.8 | 95.1 | 48.0 | 121.197566 | 0.476907267 | 0.784669224 | 0.396047558 |
| 23. | 42.1 | 83.3 | 34.3 | 99.43736722 | 0.423382086 | 0.837713249 | 0.34494075 |
| 24. | 62.7 | 82.4 | 38.1 | 110.3297784 | 0.568296256 | 0.746851858 | 0.345328347 |
| 25. | 25.5 | 75.4 | 22.6 | 82.74158567 | 0.308188437 | 0.911270909 | 0.273139556 |
| 26. | 44.1 | 69.6 | 35.3 | 89.63849619 | 0.491976125 | 0.776452115 | 0.393804018 |
| 27. | 15.7 | 69.6 | 15.7 | 73.05573215 | 0.214904423 | 0.952697317 | 0.214904423 |
| 28. | 13.7 | 41.2 | 13.8 | 45.55842403 | 0.300712772 | 0.904333301 | 0.302907756 |
| 29. | 61.7 | 76.5 | 53.9 | 112.0908114 | 0.550446546 | 0.682482347 | 0.480860111 |
| 30. | 18.6 | 50.9 | 19.6 | 57.62751079 | 0.32276251 | 0.883258695 | 0.340115333 |
| Mean | 41.1 | 76.9 | 29.5 |  | 0.409303466 | 0.840165086 | 0.307407044 |
|  |  |  | Gaussian Distribution | | 0.136964609 | 0.088912326 | 0.073685176 |
|  |  |  |  | | 0.273929217 | 0.177824652 | 0.147370352 |

Yellow can:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | R | G | B |  |  |  |  |
| 1. | 144.1 | 77.5 | 17.7 | 164.573236 | 0.875598023 | 0.470914967 | 0.107550902 |
| 2. | 143.1 | 71.6 | 15.7 | 160.7814044 | 0.8900283 | 0.445325131 | 0.097648108 |
| 3. | 139.2 | 56.9 | 17.7 | 151.4184269 | 0.919306869 | 0.375779891 | 0.116894623 |
| 4. | 122.6 | 56.9 | 13.7 | 135.8530824 | 0.902445479 | 0.41883481 | 0.100844234 |
| 5. | 125.5 | 66.7 | 15.7 | 142.9882163 | 0.877694703 | 0.466472005 | 0.109799258 |
| 6. | 120.6 | 60.8 | 13.7 | 135.7523112 | 0.888382665 | 0.447874511 | 0.100919092 |
| 7. | 116.7 | 45.1 | 12.8 | 125.7646214 | 0.927923916 | 0.358606415 | 0.10177743 |
| 8. | 127.5 | 65.7 | 15.7 | 144.2887036 | 0.883645059 | 0.455337101 | 0.108809627 |
| 9. | 131.3 | 73.6 | 15.7 | 151.337834 | 0.867595343 | 0.486329149 | 0.103741408 |
| 10. | 141.2 | 63.7 | 16.7 | 155.8012195 | 0.906283022 | 0.408854309 | 0.107187864 |
| 11. | 141.2 | 70.6 | 14.7 | 158.5493299 | 0.890574562 | 0.445287281 | 0.092715624 |
| 12. | 175.5 | 101.9 | 17.7 | 203.7084927 | 0.8615252 | 0.500224604 | 0.086888866 |
| 13. | 131.4 | 75.5 | 16.7 | 152.4634382 | 0.861845971 | 0.495200691 | 0.109534458 |
| 14. | 147.1 | 82.3 | 18.6 | 169.5808362 | 0.867432921 | 0.485314272 | 0.109682205 |
| 15. | 140.2 | 119.6 | 16.7 | 185.0380772 | 0.75768189 | 0.646353452 | 0.090251694 |
| 16. | 150.9 | 77.5 | 17.7 | 170.5589341 | 0.884738175 | 0.454388393 | 0.103776446 |
| 17. | 151.0 | 77.4 | 17.7 | 170.6020223 | 0.88510088 | 0.453687471 | 0.103750236 |
| 18. | 143.1 | 109.8 | 23.5 | 181.8952996 | 0.786716316 | 0.603643966 | 0.129195202 |
| 19. | 139.2 | 59.8 | 18.6 | 152.6389203 | 0.911956136 | 0.39177426 | 0.121856208 |
| 20. | 133.4 | 90.2 | 23.6 | 162.7530645 | 0.819646625 | 0.554213835 | 0.14500495 |
| 21. | 137.3 | 72.6 | 17.7 | 156.3180732 | 0.878337336 | 0.464437659 | 0.113230669 |
| 22. | 141.2 | 60.8 | 14.7 | 154.4350025 | 0.9143005 | 0.393693133 | 0.095185675 |
| 23. | 250.0 | 85.2 | 32.3 | 266.0870722 | 0.939542075 | 0.320195939 | 0.121388836 |
| 24. | 167.6 | 85.2 | 20.6 | 189.1379391 | 0.88612576 | 0.450464885 | 0.108915219 |
| 25. | 169.7 | 83.3 | 22.6 | 190.3883925 | 0.891335852 | 0.437526673 | 0.118704716 |
| 26. | 155.9 | 73.5 | 18.6 | 173.3580687 | 0.899294744 | 0.423977958 | 0.107292381 |
| 27. | 164.7 | 75.4 | 23.5 | 182.656782 | 0.901691129 | 0.41279606 | 0.128656597 |
| 28. | 165.7 | 85.3 | 23.5 | 187.8425671 | 0.882121676 | 0.454103675 | 0.125104764 |
| 29. | 168.6 | 69.6 | 24.5 | 184.0390448 | 0.916109949 | 0.37818062 | 0.133123925 |
| 30. | 133.3 | 70.6 | 15.7 | 151.6566517 | 0.878959139 | 0.465525245 | 0.103523319 |
| Mean | 144.1 | 77.5 | 17.7 | 164.573236 | 0.875598023 | 0.470914967 | 0.107550902 |
|  |  |  | Gaussian Distribution | | 0.037265405 | 0.065474555 | 0.013064422 |
|  |  |  |  | | 0.07453081 | 0.130949111 | 0.026128844 |

Red can:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | R | G | B |  |  |  |  |
| 1. | 145.2 | 15.7 | 11.8 | 146.5222509 | 0.990975767 | 0.107150961 | 0.080533843 |
| 2. | 165.7 | 15.7 | 15.7 | 167.1809499 | 0.991141635 | 0.093910221 | 0.093910221 |
| 3. | 187.2 | 12.8 | 29.4 | 189.9264068 | 0.98564493 | 0.067394525 | 0.1547968 |
| 4. | 150.9 | 9.8 | 13.8 | 151.8462709 | 0.993768231 | 0.064538957 | 0.090881389 |
| 5. | 150.9 | 14.3 | 11.8 | 152.0346671 | 0.992536787 | 0.094057495 | 0.077613877 |
| 6. | 155.9 | 14.7 | 10.7 | 156.9566501 | 0.993267886 | 0.093656433 | 0.068171689 |
| 7. | 154.9 | 17.6 | 12.7 | 156.4131069 | 0.990326214 | 0.11252254 | 0.081195242 |
| 8. | 149.0 | 17.6 | 12.7 | 150.5724078 | 0.989557132 | 0.116887285 | 0.084344802 |
| 9. | 161.7 | 20.6 | 14.7 | 163.6683842 | 0.987973339 | 0.12586426 | 0.089815758 |
| 10. | 155.9 | 14.7 | 14.7 | 157.2799733 | 0.991226008 | 0.093463902 | 0.093463902 |
| 11. | 141.2 | 8.8 | 12.8 | 142.0518215 | 0.994003445 | 0.061949223 | 0.090107961 |
| 12. | 140.2 | 8.8 | 12.7 | 141.0488213 | 0.993982074 | 0.062389745 | 0.090039746 |
| 13. | 200.0 | 8.8 | 28.4 | 202.1979228 | 0.989129845 | 0.043521713 | 0.140456438 |
| 14. | 150.9 | 13.7 | 11.7 | 151.971675 | 0.992948193 | 0.090148378 | 0.076988031 |
| 15. | 167.7 | 31.4 | 14.7 | 171.2464306 | 0.979290484 | 0.183361486 | 0.085841205 |
| 16. | 160.7 | 16.7 | 10.7 | 161.9193318 | 0.992469511 | 0.103137777 | 0.066082289 |
| 17. | 172.5 | 15.7 | 15.6 | 173.9140592 | 0.991869207 | 0.090274473 | 0.089699476 |
| 18. | 181.4 | 17.7 | 17.7 | 183.1189231 | 0.990613078 | 0.096658498 | 0.096658498 |
| 19. | 166.7 | 21.6 | 14.7 | 168.7351179 | 0.987938979 | 0.128011289 | 0.087118794 |
| 20. | 169.5 | 26.4 | 16.7 | 172.3545764 | 0.983437769 | 0.153172608 | 0.096893279 |
| 21. | 166.7 | 21.6 | 13.7 | 168.6509413 | 0.988432076 | 0.128075182 | 0.08123287 |
| 22. | 129.4 | 13.7 | 9.8 | 130.4917239 | 0.991633769 | 0.104987501 | 0.075100548 |
| 23. | 115.7 | 8.8 | 8.8 | 116.3673923 | 0.994264782 | 0.075622559 | 0.075622559 |
| 24. | 143.1 | 13.7 | 11.7 | 144.2296433 | 0.992167745 | 0.615030373 | 0.525244917 |
| 25. | 121.6 | 10.8 | 9.8 | 122.4713844 | 0.992884996 | 0.088183865 | 0.080018692 |
| 26. | 118.7 | 13.8 | 9.8 | 119.9006672 | 0.989986151 | 0.115095273 | 0.081734324 |
| 27. | 118.8 | 12.8 | 9.8 | 119.8887818 | 0.990918401 | 0.106765619 | 0.081742427 |
| 28. | 135.3 | 14.7 | 10.8 | 136.5240638 | 0.99103408 | 0.107673326 | 0.079106933 |
| 29. | 123.6 | 13.0 | 8.8 | 124.5929372 | 0.99203055 | 0.104339783 | 0.070630007 |
| 30. | 115.7 | 16.7 | 8.8 | 117.2297744 | 0.986950633 | 0.142455277 | 0.075066254 |
| Mean | 146.2 | 15.4 | 13.5 |  | 0.990413457 | 0.119010018 | 0.102003759 |
|  |  |  | Gaussian Distribution | | 0.003257299 | 0.09636383 | 0.094796834 |
|  |  |  |  | | 0.006514597 | 0.192727659 | 0.189593667 |

Set the blue can as the target can and run 4 times.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Detected | Return | R | G | B | Euclidean Distance d | Actual Position | Grid Intersection |
| 1. | Yes | Blue | 26.7 | 40.5 | 54.6 | 10.523 | (3.95, 3.94) | (4, 4) |
| 2. | Yes | Blue | 16.0 | 58.7 | 53.6 | 16.166 | (3.94, 3.91) | (4, 4) |
| 3. | Yes | Blue | 12.3 | 26.4 | 49.7 | 30.169 | (3.93, 3.90) | (4, 4) |
| 4. | Yes | Blue | 64.7 | 76.4 | 58.2 | 43.561 | (3.93, 3.93) | (4, 4) |

Set the green can as the target can and run 4 times.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Detected | Return | R | G | B | Euclidean Distance d | Actual Position | Grid Intersection |
| 1. | Yes | Green | 56.8 | 78.0 | 45.2 | 11.096 | (4.89, 4.90) | (5, 5) |
| 2. | Yes | Green | 68.3 | 89.2 | 35.5 | 15.726 | (4.91, 4.90) | (5, 5) |
| 3. | Yes | Green | 76.3 | 90.2 | 45.0 | 25.444 | (4.90, 4.91) | (5, 5) |
| 4. | Yes | Green | 16.0 | 70.4 | 14.8 | 44.914 | (4.89, 4.89) | (5, 5) |

Set the yellow can as the target can and run 4 times.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Detected | Return | R | G | B | Euclidean Distance d | Actual Position | Grid Intersection |
| 1. | Yes | Yellow | 140.3 | 75.3 | 17.7 | 7.185 | (5.86, 5.87) | (6, 6) |
| 2. | Yes | Yellow | 140.5 | 60.0 | 17.7 | 8.464 | (5.88, 5.88) | (6, 6) |
| 3. | Yes | Yellow | 129.2 | 62.2 | 15.3 | 14.422 | (5.85, 5.89) | (6, 6) |
| 4. | Yes | Yellow | 158.1 | 75.8 | 20.3 | 17.910 | (5.87, 5.85) | (6, 6) |

Set the red can as the target can and run 4 times.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Detected | Return | R | G | B | Euclidean Distance d | Actual Position | Grid Intersection |
| 1. | Yes | Red | 150.0 | 9.9 | 14.8 | 4.824 | (6.81, 4.85) | (7, 5) |
| 2. | Yes | Red | 150.0 | 8.8 | 14.7 | 5.547 | (6.80, 4.81) | (7, 5) |
| 3. | Yes | Red | 147.7 | 10.4 | 13.7 | 6.608 | (6.82, 4.82) | (7, 5) |
| 4. | Yes | Red | 167.6 | 22.1 | 14.1 | 16.622 | (6.80, 4.83) | (7, 5) |

**Test Analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Blue can | Green can | Yellow can | Red can |
| Mean | : 0.33517449 : 0.60333634 : 0.68564513 | : 0.40930347 : 0.84016509 : 0.30740704 | : 0.87895914 : 0.46552525 : 0.10352332 | : 0.99041346 : 0.10167525 : 0.08719962 |
| Standard deviation | : 0.14297912 : 0.12094359 : 0.13588118 | : 0.13696446 : 0.08891233 : 0.07368518 | : 0.0372654 : 0.06547456 : 0.01306442 | : 0.00325799 : 0.09636383 : 0.09479683 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample: | Blue | Blue | Blue | Green | Green | Green | Yellow | Yellow | Yellow | Red | Red | Red |
| Total Number | 30.000 | 30.000 | 30.000 | 30.000 | 30.000 | 30.000 | 30.000 | 30.000 | 30.000 | 30.000 | 30.000 | 30.000 |
| Max Value | 0.608 | 0.859 | 0.922 | 0.617 | 0.956 | 0.481 | 0.940 | 0.646 | 0.145 | 0.994 | 0.183 | 0.155 |
| Min Value | 0.129 | 0.365 | 0.411 | 0.215 | 0.679 | 0.172 | 0.758 | 0.320 | 0.087 | 0.979 | 0.044 | 0.066 |
| Range | 0.479 | 0.494 | 0.511 | 0.139 | 0.090 | 0.075 | 0.182 | 0.326 | 0.058 | 0.015 | 0.140 | 0.089 |
| Horizontal Position: |  |  |  |  |  |  |  |  |  |  |  |  |
| Upper Limit | 0.814 | 1.098 | 1.196 | 0.688 | 1.021 | 0.532 | 1.064 | 0.778 | 0.168 | 1.005 | 0.242 | 0.176 |
| Lower Limit | 0.129 | 0.365 | 0.411 | 0.131 | 0.659 | 0.158 | 0.758 | 0.320 | 0.087 | 0.979 | -0.096 | -0.002 |
| Span | 0.685 | 0.733 | 0.785 | 0.557 | 0.362 | 0.375 | 0.306 | 0.458 | 0.081 | 0.026 | 0.338 | 0.177 |
| Number of Cylinder | 6.000 | 6.000 | 6.000 | 6.000 | 6.000 | 6.000 | 6.000 | 6.000 | 6.000 | 6.000 | 6.000 | 6.000 |
| Span of Cylinder | 0.125 | 0.134 | 0.143 | 0.023 | 0.066 | 0.068 | 0.056 | 0.084 | 0.015 | 0.005 | 0.062 | 0.032 |

The below table and diagram is for the sample listed above from left to right.

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| 0.129 | 1.000 | 0.986 |
| 0.272 | 11.000 | 2.530 |
| 0.415 | 10.000 | 2.389 |
| 0.558 | 5.000 | 0.830 |
| 0.701 | 3.000 | 0.106 |
| 0.844 | 0.000 | 0.005 |

**Figure 1: Normal Distribution of R for Blue Can**

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| 0.365 | 1.000 | 0.472 |
| 0.486 | 6.000 | 2.058 |
| 0.607 | 7.000 | 3.297 |
| 0.728 | 12.000 | 1.944 |
| 0.849 | 2.000 | 0.421 |
| 0.970 | 2.000 | 0.034 |

**Figure 2: Normal Distribution of G for Blue Can**

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| 0.411 | 1.000 | 0.382 |
| 0.547 | 5.000 | 1.747 |
| 0.683 | 10.000 | 2.935 |
| 0.819 | 7.000 | 1.815 |
| 0.955 | 7.000 | 0.413 |
| 1.091 | 0.000 | 0.035 |

**Figure 3: Normal Distribution of B for Blue Can**

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| 0.131 | 0.000 | 0.368 |
| 0.268 | 6.000 | 1.706 |
| 0.405 | 8.000 | 2.911 |
| 0.542 | 8.000 | 1.827 |
| 0.679 | 8.000 | 0.422 |
| 0.816 | 0.000 | 0.036 |

**Figure 4: Normal Distribution of R for Green Can**

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| 0.659 | 0.000 | 0.567 |
| 0.748 | 8.000 | 2.628 |
| 0.837 | 6.000 | 4.484 |
| 0.926 | 9.000 | 2.814 |
| 1.015 | 7.000 | 0.650 |
| 1.104 | 0.000 | 0.055 |

**Figure 5: Normal Distribution of G for Green Can**

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| 0.158 | 0.000 | 0.684 |
| 0.231 | 6.000 | 3.172 |
| 0.305 | 10.000 | 5.411 |
| 0.379 | 9.000 | 3.396 |
| 0.452 | 4.000 | 0.784 |
| 0.526 | 1.000 | 0.067 |

**Figure 6: Normal Distribution of B for Green Can**

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| 0.758 | 1.000 | 0.042 |
| 0.795 | 1.000 | 0.708 |
| 0.832 | 1.000 | 4.417 |
| 0.869 | 4.000 | 10.136 |
| 0.907 | 17.000 | 8.557 |
| 0.944 | 6.000 | 2.657 |

**Figure 7: Normal Distribution of R for Yellow Can**

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| 0.320 | 1.000 | 0.799 |
| 0.386 | 3.000 | 3.637 |
| 0.451 | 11.000 | 6.092 |
| 0.517 | 12.000 | 3.754 |
| 0.582 | 1.000 | 0.851 |
| 0.648 | 2.000 | 0.071 |

**Figure 8: Normal Distribution of G for Yellow Can**

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| 0.087 | 1.000 | 6.302 |
| 0.100 | 4.000 | 22.588 |
| 0.113 | 15.000 | 29.784 |
| 0.126 | 6.000 | 14.447 |
| 0.139 | 3.000 | 2.578 |
| 0.152 | 1.000 | 0.169 |

**Figure 9: Normal Distribution of B for Yellow Can**

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| 0.979 | 1.000 | 3.60E-01 |
| 0.983 | 0.000 | 6.635 |
| 0.986 | 2.000 | 45.020 |
| 0.989 | 4.000 | 112.381 |
| 0.992 | 14.000 | 103.201 |
| 0.996 | 9.000 | 34.864 |

**Figure 10: Normal Distribution of R for Red Can**

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| -0.096 | 0.000 | 0.502 |
| 0.000 | 0.000 | 2.374 |
| 0.096 | 14.000 | 4.134 |
| 0.193 | 16.000 | 2.648 |
| 0.289 | 0.000 | 0.624 |
| 0.386 | 0.000 | 0.054 |

**Figure 11: Normal Distribution of G for Red Can**

|  |  |  |
| --- | --- | --- |
| Group Statistics | Number of Frequency | Rate of Frequency |
| -0.002 | 0.000 | 2.716 |
| 0.093 | 24.000 | 4.200 |
| 0.188 | 6.000 | 2.389 |
| 0.283 | 0.000 | 0.500 |
| 0.378 | 0.000 | 0.038 |
| 0.472 | 0.000 | 0.001 |

**Figure 12: Normal Distribution of B for Red Can**

The method we used to determine can position is that use the value shown on the odometer plus the default distance from the ultrasonic sensor to the can. And then round that value to the nearest grid intersection value for both x and y. So as a result, we can get the estimated position of the can.