Dynamic Path Following Robot using Vision Based Controls

By: Amar Bhatt & Rasika Kangutkar

Goals

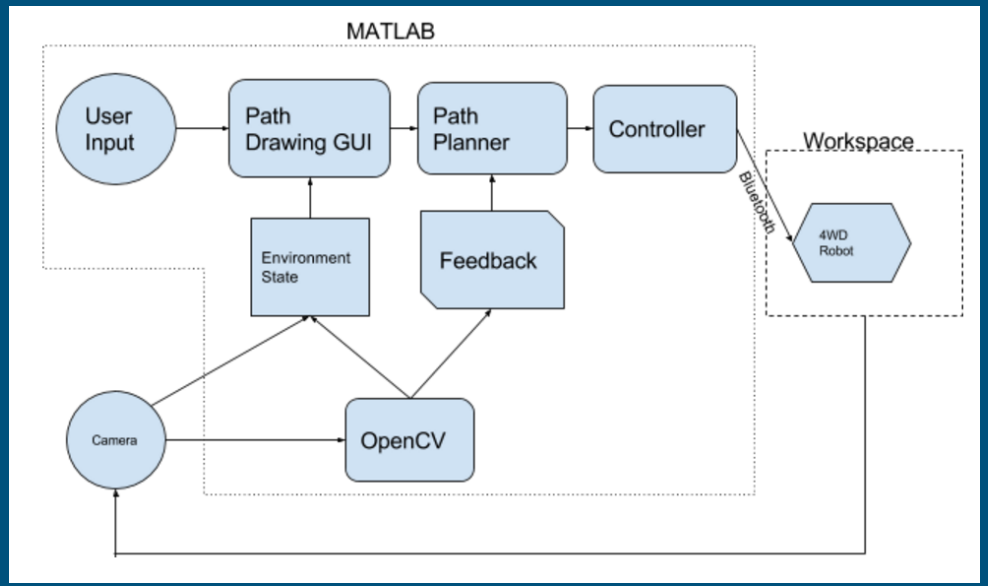
Create a low-cost Automatic Guided Vehicle (AVG)

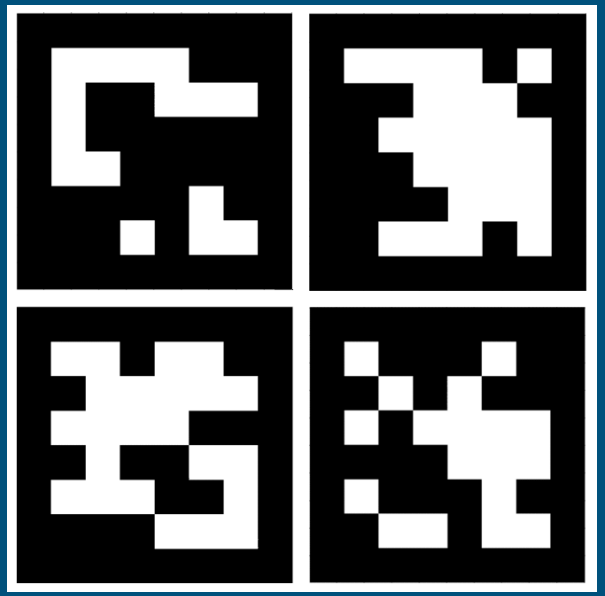
System must be wireless

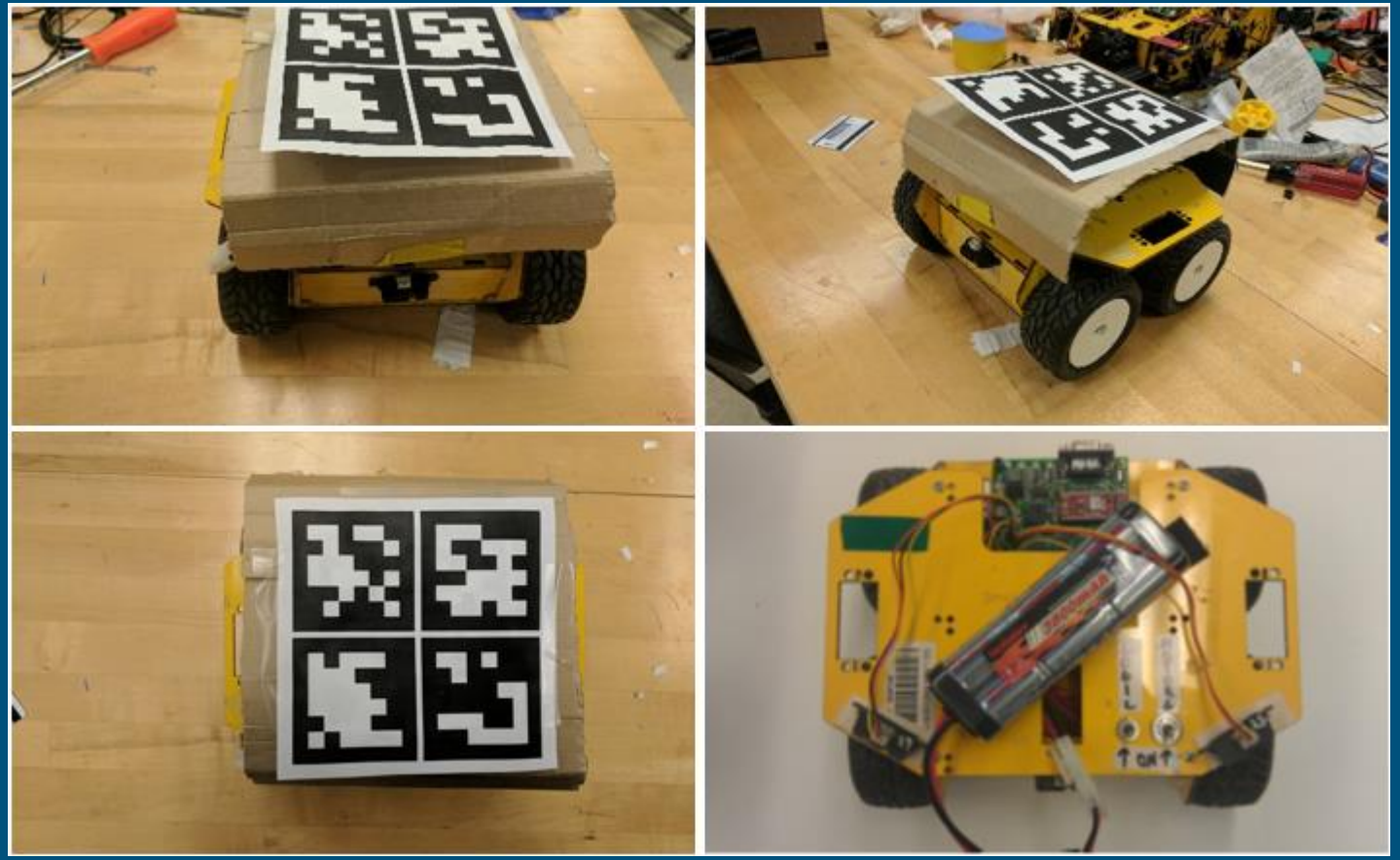
Implement a user interface to control robot path

Implement vision based control algorithm

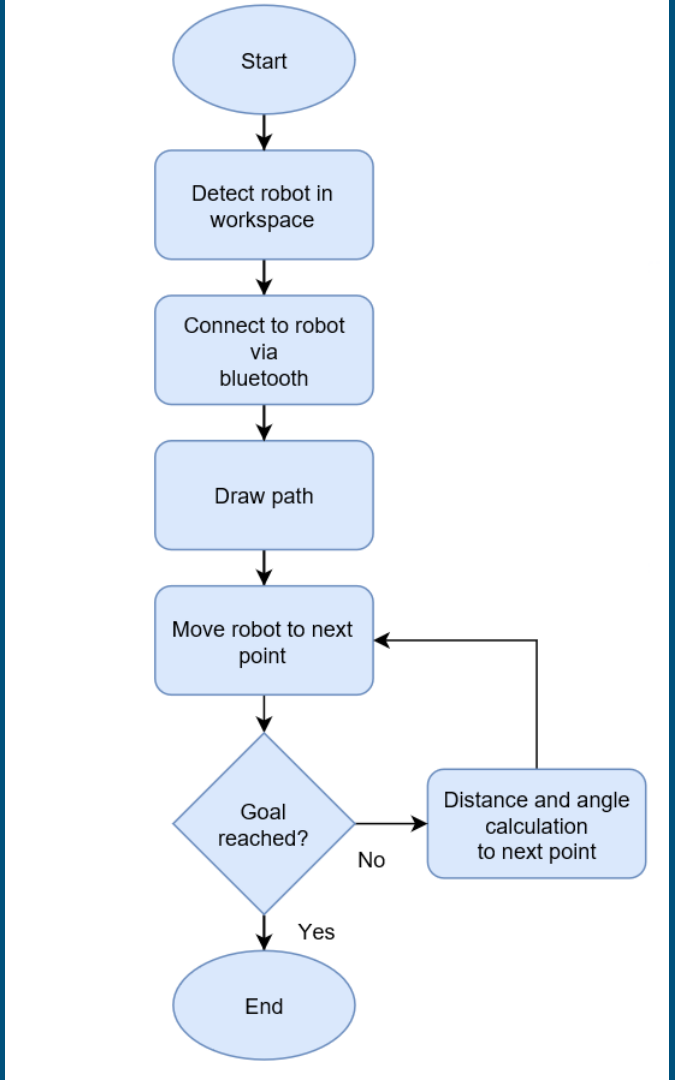
System Overview



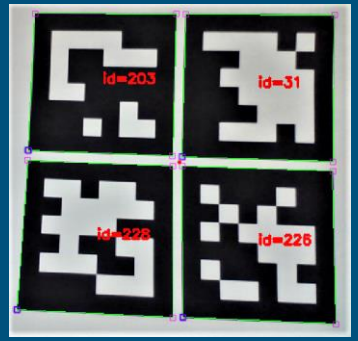




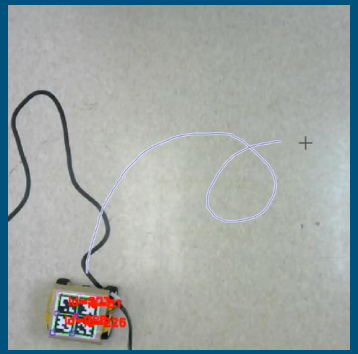
Procedure


Start
Detect robot in workspace
Connect to robot via bluetooth
Draw path
Move robot to next point
Goal reached?
No
Distance and angle calculation to next point
Yes
End

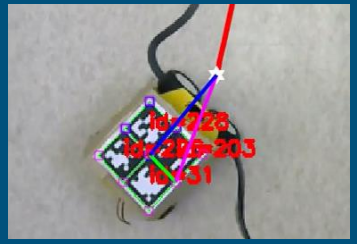
1. Detect ArUco Markers



2. Drawing a Path



3. Accuracy Thresholds

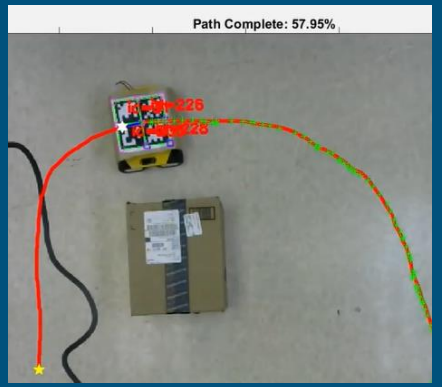


$$d = \sqrt{(x_c - x_g)^2 + (y_c - y_g)^2}$$

$$a = V_o \cdot V_g$$

$$\theta = atan2(V_{g_x} * V_{n_y} - V_{g_y} * V_{n_x}, V_{g_x} * V_{n_x} + V_{g_y} * V_{n_y})$$

4. Following the Path



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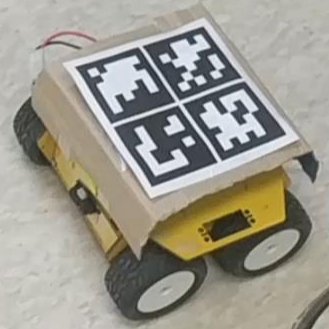
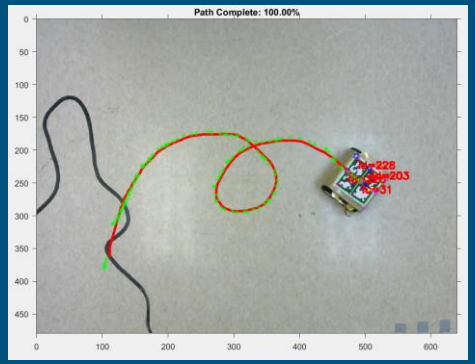
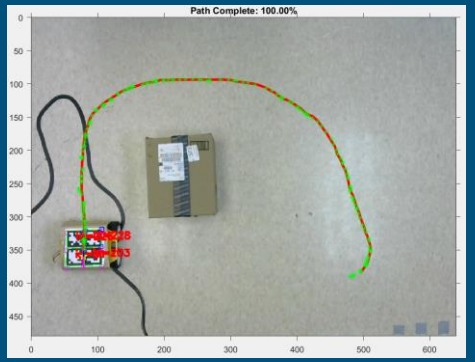
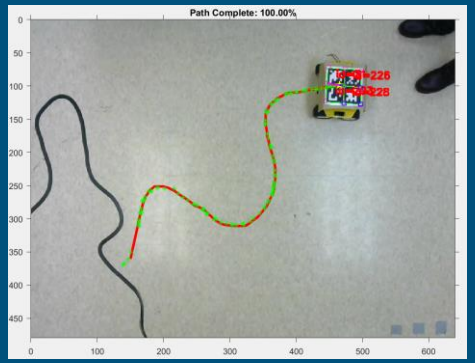
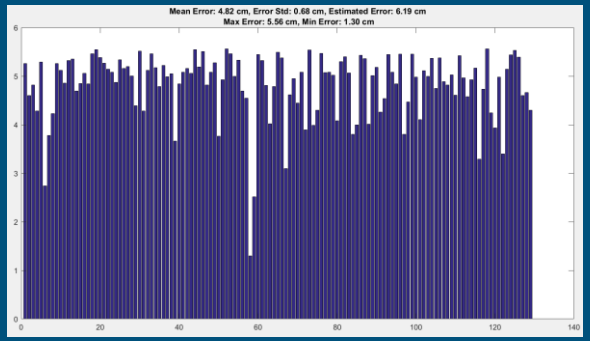


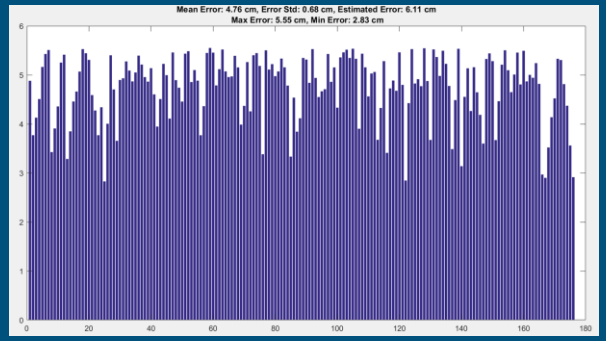
Results

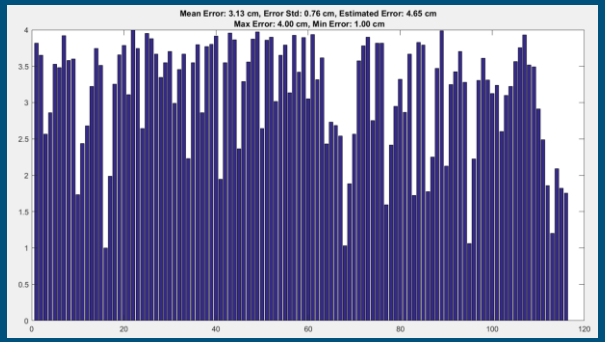

Path Complete: 100.00%


Path Complete: 100.00%


Path Complete: 100.00%


Mean Error: 4.82 cm, Error Std: 0.68 cm, Estimated Error: 6.19 cm
Max Error: 5.56 cm, Min Error: 1.30 cm


Mean Error: 4.76 cm, Error Std: 0.68 cm, Estimated Error: 6.11 cm
Max Error: 5.55 cm, Min Error: 2.83 cm


Mean Error: 3.13 cm, Error Std: 0.76 cm, Estimated Error: 4.65 cm
Max Error: 4.00 cm, Min Error: 1.00 cm

Results (continued...)

ERROR ANALYSIS

a^*	d^*	STD	Mean Error	Max Error	Min Error	Estimated Error
0.95	20	0.68	4.82	5.56	1.30	6.19
0.99	20	0.68	4.76	5.55	2.83	6.11
0.99	15	0.76	3.13	4.01	1.00	4.65

Error in cm, d^* in px
a^*= orientation threshold, d^* = distance threshold

Conclusion & Future Work

Threshold cannot be too small

Timing Threshold is important to not overflow serial buffer

Decreasing distance threshold causes an increase in orientation threshold

Obstacle avoidance

Multiple camera tracking

Multiple agents