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RRT Motion Planning for Franka Emika 7 DoF Robot Arm

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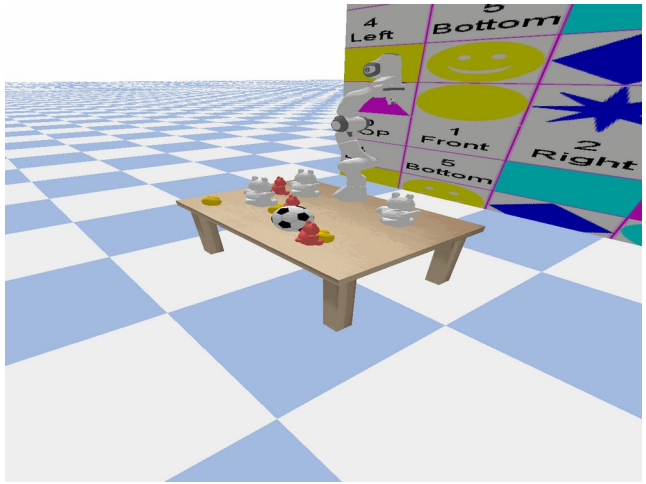
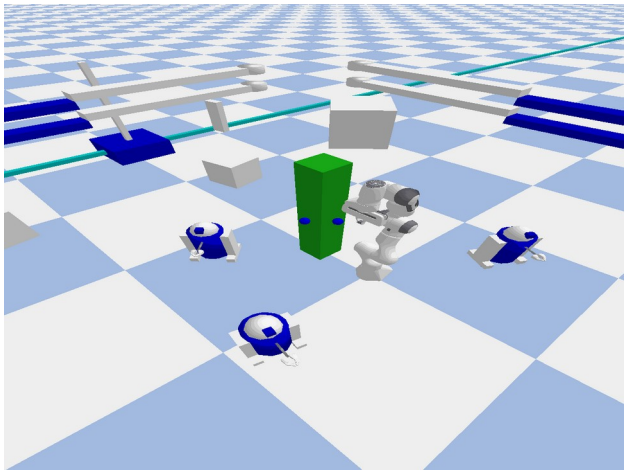
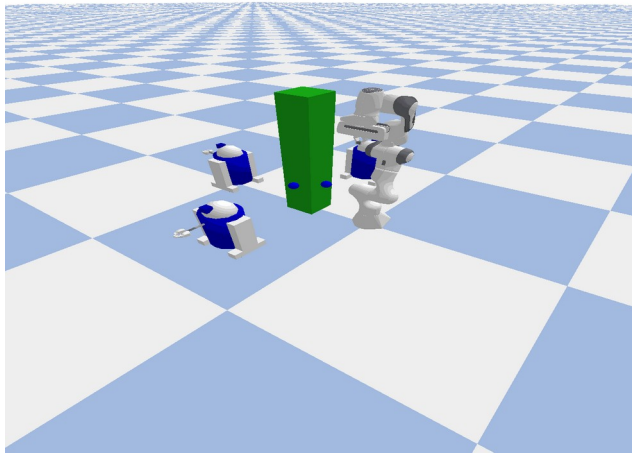
RRT Planning

	Running Time(s)	Hit Obstacle	Reach Goal
Env1	4.5	0/3	3/3
Env2	32	1/3	2/3
Env3	50	2/2	0/2

- Efficiently explores high-dimensional spaces for path planning.
- Grows tree incrementally from the start position towards random samples in the space.
- Prioritizes exploration over optimization, producing feasible but suboptimal paths.
- Works well in environments with complex obstacles.
- Paths may appear jagged and inefficient.
- Often requires post-processing to smooth the path.
- Fast but may struggle to find paths in narrow passages.







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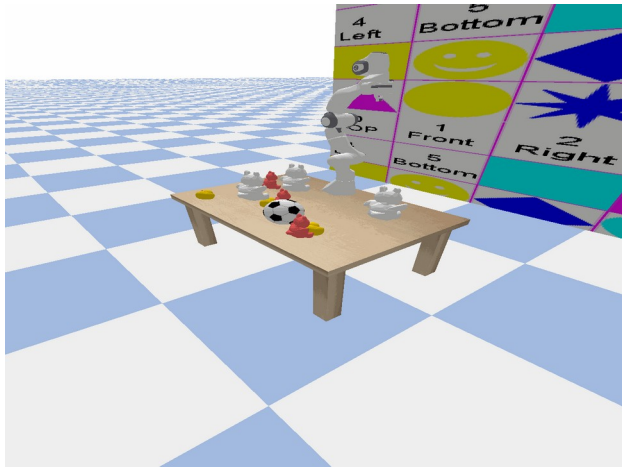

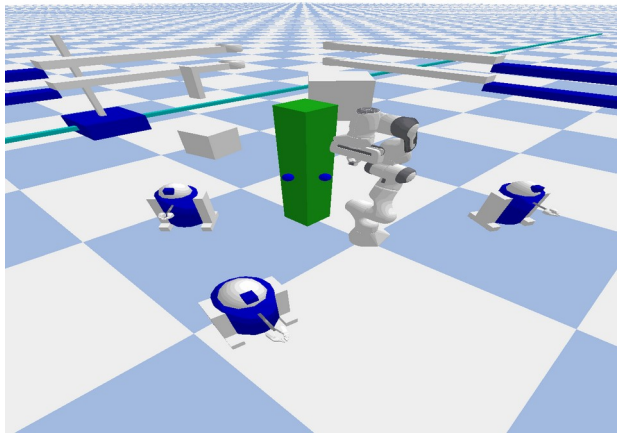

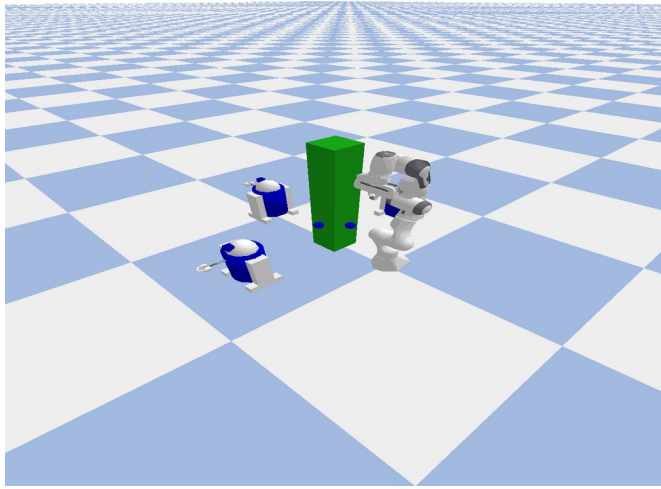

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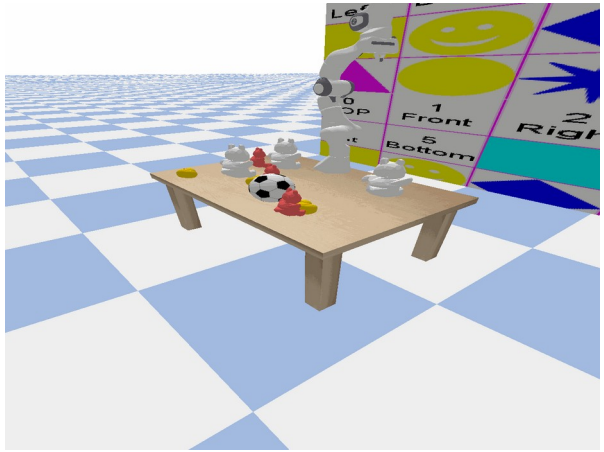
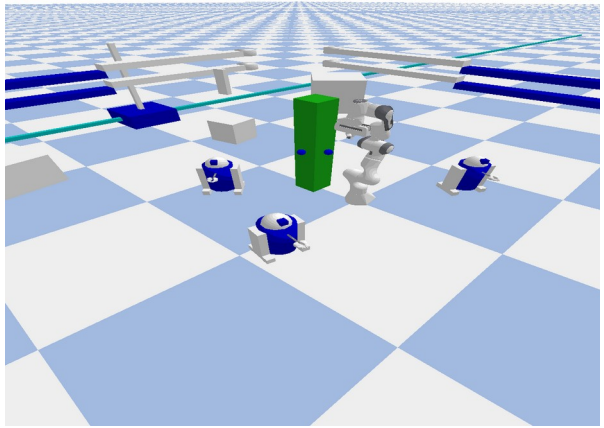
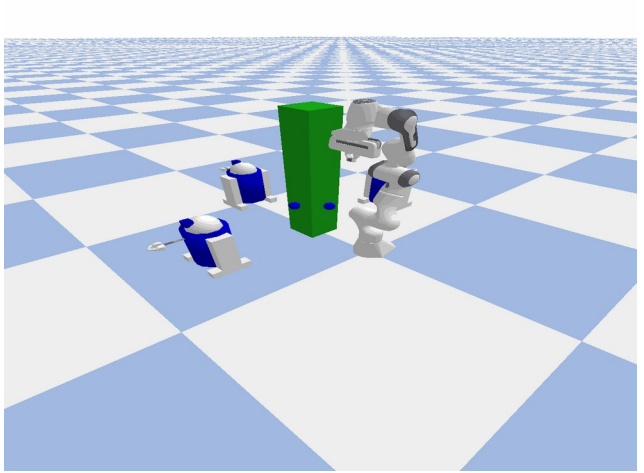
RRT* Planning

	Running Time	Hit Obstacle	Reach Goal
Env1	7.8	0/3	3/3
Env2	16	3/3	2/3
Env3	20	1/2	2/2

- Builds on RRT by refining the tree to find near-optimal paths.
- Introduces a "rewiring" step to minimize path cost during growth.
- Guarantees asymptotic optimality as the number of iterations increases.
- Slower than RRT but generates smoother, shorter paths.
- Paths are significantly shorter and smoother compared to RRT.
- Computationally intensive, especially in complex environments.
- Requires more iterations for high-quality solutions.







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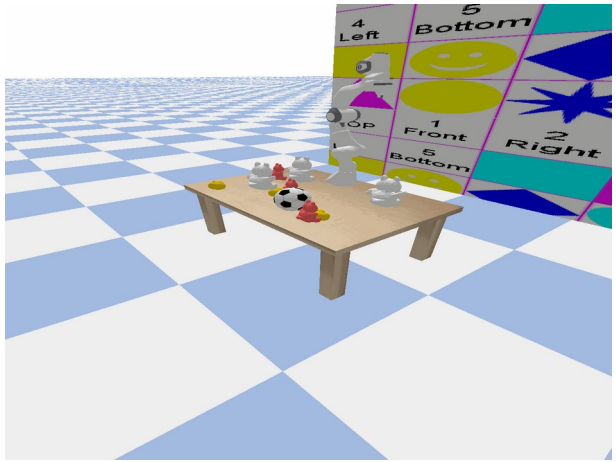

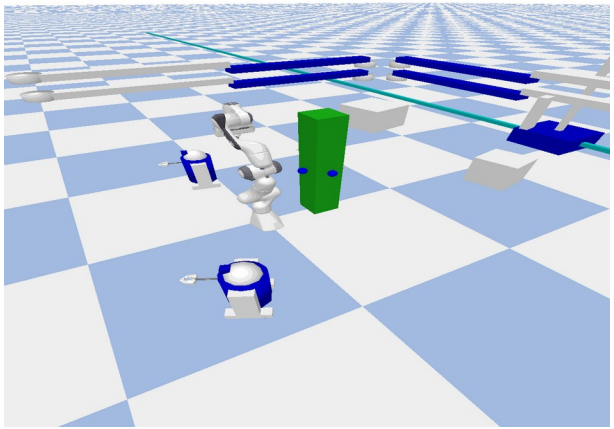

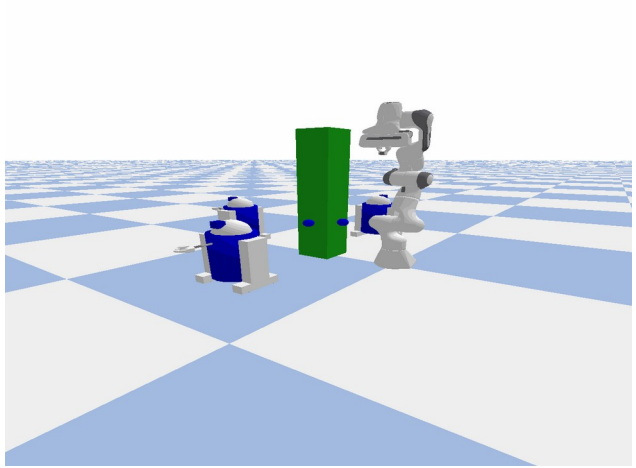

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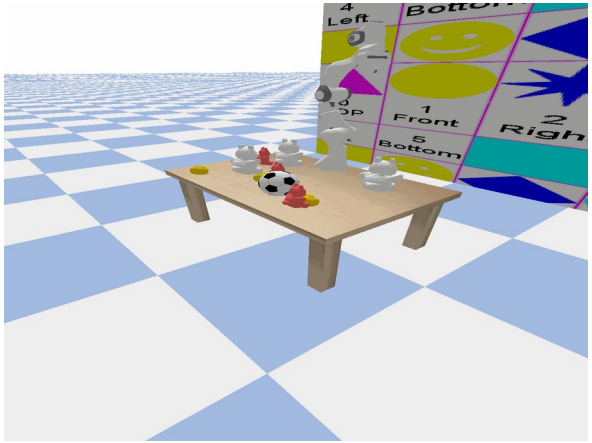
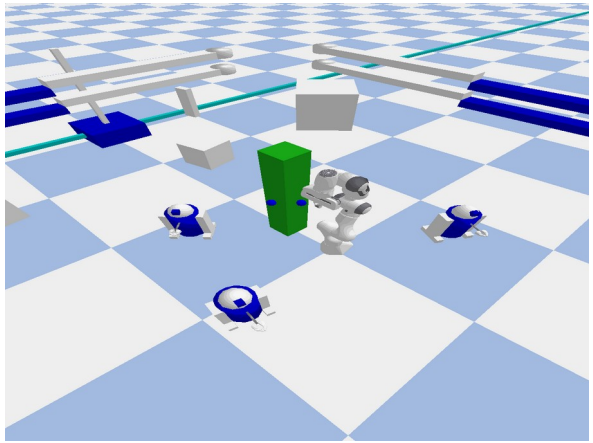
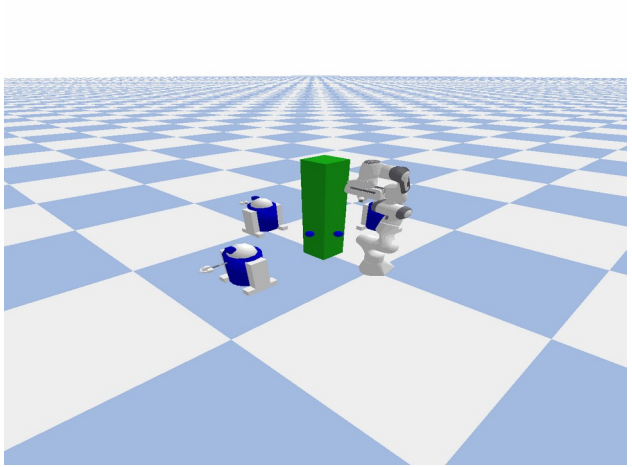
RRT* based Obstacle Proximity scan and avoid

	Running Time	Hit Obstacle	Reach Goal
Env1	5.5	0/3	3/3
Env2	27	1/3	2/3
Env3	18	1/2	2/2

- Enhances RRT* by factoring obstacle proximity into path optimization.
- Penalizes paths that pass too close to obstacles, improving safety.
- Balances path length and safety during rewiring and expansion.
- Useful in environments with dynamic obstacles or high-risk zones.
- Paths maintain safety margins from obstacles.
- Slightly longer paths compared to standard RRT*, trading off optimality for safety.
- Effective in ensuring robust paths in cluttered or dynamic settings.







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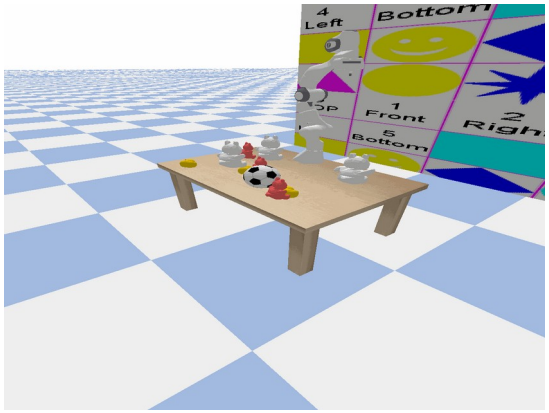

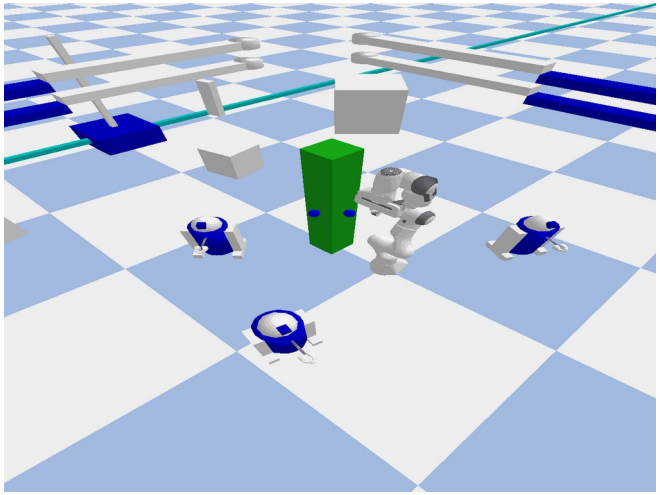

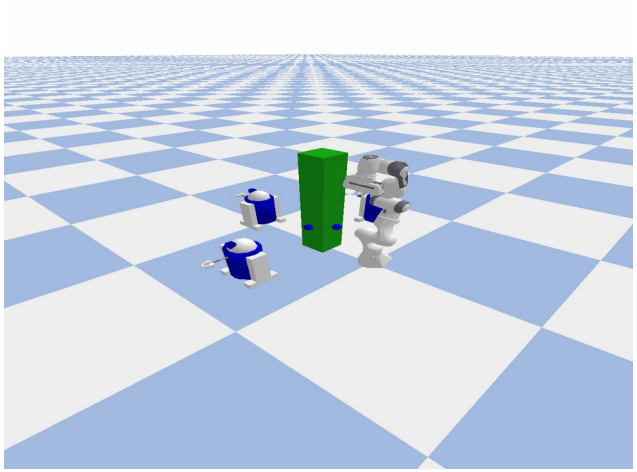

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