Report #3

Rev 1.0

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Product Specifications

Assumptions:

- The software will run on the Player/Stage simulation platform, using the Gazebo 3D simulator.
- The "urban environment" simulated in Gazebo will be an open field filled with crude 3D boxes representing buildings, power lines, and other obstacles.
- The simulated helicopter in Gazebo will possess a laser range finder, allowing it to determine the distance between itself and the objects in its environment. This laser range finder will be based on a Fibertek laser scanner, which has a field of view of 30 x 40 degrees, a frame rate of 1.3, a blind distance of 14 m, a maximum 6 mm black wire detection range of 58 m, an angular resolution of 2 mrad, and a range resolution of less than 2 m.
- The global and local path planners and the speed controller will be based on those described in "Flying Fast and Low Among Obstacles: Methodology and Experiments," S. Scherer, S. Singh, L. Chamberlain, M. Elgersma, *The International Journal of Robotics Research*, vol. 27, pp. 549-574, May 2008.

Features:

- The software will have five modules: the main program, occupancy grid creator, global path planner, local path planner, and speed controller.
- The simulated environment:
  - will be alterable independent of the control software. This includes changing the obstacles, helicopter physics and sensors.
  - will have a representation of the helicopter with a rotor span of 3.1 m, a length of 3.6 m and a height of 1.1 m.
- The main program:
  - will have a mode allowing the simulated helicopter will be able to fly above the environment and create an occupancy grid.
  - will have a mode allowing the simulated helicopter to navigate from a set starting position to a destination through an unknown, but passable environment.
- The occupancy grid creator:
  - will be able to use the laser range finder's output to create and update an occupancy grid of the area seen.
  - will create an occupancy grid that will represent the likelihood that a particular cell contains an obstacle.
  - will create an occupancy grid that represents areas below 5m elevation, above 11m elevation, and outside a specifiable boundary as occupied.

- The global path planner:
    - will be able to use an occupancy grid and a user-specified destination to calculate a vector field of potentials that points away from obstacles and towards the destination.
    - will be capable of running in real-time, while the helicopter is in flight.
- The local path planning algorithm:
    - will provide real-time corrections to the global path plan based on newly discovered obstacles in the flight path of the helicopter.
    - will smooth out waypoints in the global path plan provide a smoother plan that will be more easily executed by the helicopter.
- The speed controller that will:
    - Adjust the speed and direction of the helicopter to follows the plan developed by the local path planner.
    - maintain a minimum stopping distance from all obstacles, guaranteeing that the helicopter will not collide with any object in the simulated environment.

Performance Specifications

The performance specifications are based on a simulation run on an computer with an AMD Athlon 64 3700+ "San Diego" processor and 2GB of RAM.

- The simulated helicopter will be able to fly at an average speed exceeding 10m/s, while navigating to a destination.
- Any obstacle free space larger than 10.8m wide by 10.8m long by 3.3m high will be passable by the helicopter.
- The global path planner will be able to update the global path faster than once per 2 seconds.

Project Schedule

Name	Work
Report 1	14d
Report #2	**24d**
R2 Gantt Chart	7d
R2 High Level Design	7d
R2 Revision	10d
Fall Final Presentation	10d
Player/Gazebo	**67d**
PG Set up Player & Gazebo	10d
PG Robot configuration files	5d
PG Create 3D Environments	52d
Occupancy Grid Creator	**45d**
OGC Programming	20d
OGC Develop Test Protocol	5d
OGC Testing	10d
OGC Revision	10d
Global Path Planner	**50d**
GPP Programming	20d
GPP Develop Test Protocol	10d
GPP Testing	10d
GPP Revision	10d
Local Path Planner	**55d**
LPP Programming	20d
LPP Develop Test Protocol	15d
LPP Testing	10d
LPP Revision	10d
Report #3	15d
Speed Controller	**55d**
SC Programming	20d
SC Develop Test Protocol	10d
SC Testing	10d
SC Revision	15d
Report #4	20d
Top Level Integration	**65d**
TL Programming	20d
TL Develop Test Protocol	15d
TL Testing	20d
TL Revision	10d
Report #5	25d
Winter Final Presentation and Poster	10d