Josh Benton Mar-17-2015 Robotics

Project 3 Grid Mapping (Part1)

The majority of the time I spent on this project was actually making utility functions to take in laser data and convert it to a set (no duplicates) of pairs, and fixing the syntax issues with pairs. along with setting up unit testing.

random walk

I re-implemented random walk for this project, and in a way that should allow implementing a more advanced path planning algorithm later. I changed the FSM to just be an integer, and used constant integers instead of the enum variables. It seems to be a nice improvement, and has allowed me to create a code system for different movement states.

currently 1000 series states refer to forward moving states and 2000 series states refer to rotating states.

Getting the laser data

Laser data is currently converted to vectors / sets of x,y coordinates of laser strikes. it seems to be working ok, but it is not production ready, and is currently disabled. (it prints to the console.)

XY vectors and sets

One of the major issues I keep running into is how to store x,y cordinates. I keep making a vector for each (one for x, one for y, sometimes one for angles).

I might need to make a custom data structure for it, as std::pairs seem to trip me up, it's really easy to forget to type std::pair, also if I make a class, I can make utility functions for the class.

Unit testing

There's a new namespace in town, IUtilsUnitTests, defined below the IUtils, which allows me to do unit testing, and I can hide the code with netbeans' bracket collapser. I also added a feature to just do unit tests and not actually run the program. ultimately without the GUI working, unit testing geometric things isn't super helpful, but I have a namespace for it.

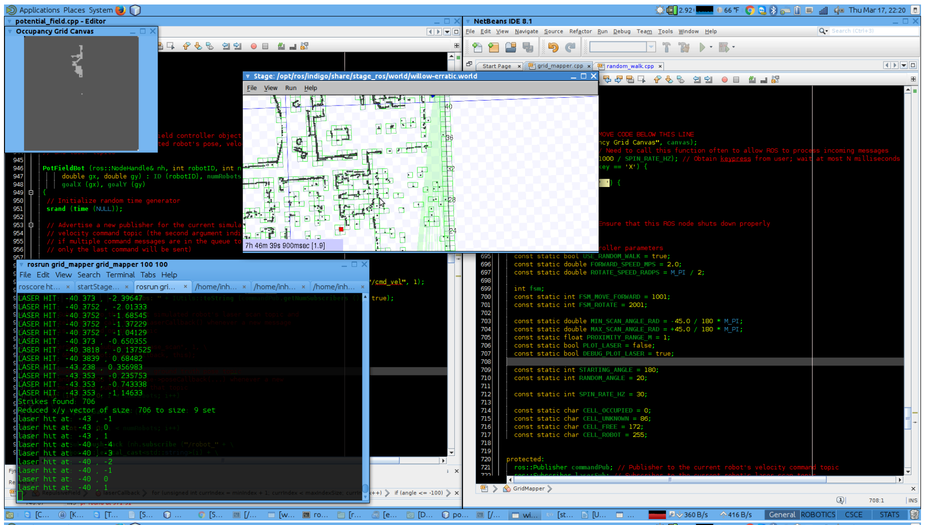
GUI Progress update

The qt5 ros gui compiles, and displays a qt5 window, is capable of drawing lines, is listening to a ros topic for those draw commmands, but I have not been able to test the actual draw commands. Hopefully with the new unit testing namespace, I can safely test that. The project is currently on github. https://github.com/90301/inhaler_gui

TODO:

> implement a set to contain all wall strikes, and a different version of the utility function that places new strikes into this set. better data-structures to hold the map. Exploration???? Getting the gui working better

Screenshots


Applications Places System
potential_field.cpp - Editor
Occupancy Grid Canvas
Stage: /opt/ros/indigo/share/stage_ros/world/willow-erratic.world
File View Run Help
7h 46m 39s 900msec [1.9]
NetBeans IDE 8.1
File Edit View Navigate Source Refactor Run Debug Team Tools Window Help
Start Page grid_mapper.cpp random_walk.cpp
GridMapper
708:1 INS
360 B/s 416 B/s General ROBOTICS CSCE STATS
Thu Mar 17, 22:20

```
PotFieldBot (ros::NodeHandle& nh, int robotID, int n
    double gx, double gy) : ID (robotID), numRobots
    goalX (gx), goalY (gy)
{
 // Initialize random time generator
 srand (time (NULL));

 // Advertise a new publisher for the current simula
 // velocity command topic (the second argument indi
 // if multiple command messages are in the queue to
 // only the last command will be sent)
```

```
rosrun grid_mapper grid_mapper 100 100
LASER HIT: -40.373 , -2.39647
LASER HIT: -40.3752 , -2.01333
LASER HIT: -40.3752 , -1.68545
LASER HIT: -40.3752 , -1.37229
LASER HIT: -40.3752 , -1.04129
LASER HIT: -40.373 , -0.650355
LASER HIT: -40.3818 , -0.137525
LASER HIT: -40.3839 , 0.68482
LASER HIT: -43.238 , 0.356983
LASER HIT: -43.353 , -0.235753
LASER HIT: -43.353 , -0.743338
LASER HIT: -43.353 , -1.14633
Strikes found: 706
Reduced x/y vector of size: 706 to size: 9 set
laser hit at: -43 , -1
laser hit at: -43 , 0
laser hit at: -43 , 1
laser hit at: -40 , -4
laser hit at: -40 , -3
laser hit at: -40 , -2
laser hit at: -40 , -1
laser hit at: -40 , 0
laser hit at: -40 , 1
```

```
MOVE CODE BELOW THIS LINE
ncy Grid Canvas", canvas);
/ Need to call this function often to allow ROS to process incoming messages
1000 / SPIN_RATE_HZ); // Obtain keypress from user; wait at most N milliseconds
key == 'X') {

Ensure that this ROS node shuts down properly

roller parameters
  const static bool USE_RANDOM_WALK = true;
  const static double FORWARD_SPEED_MPS = 2.0;
  const static double ROTATE_SPEED_RADPS = M_PI / 2;

  int fsm;
  const static int FSM_MOVE_FORWARD = 1001;
  const static int FSM_ROTATE = 2001;

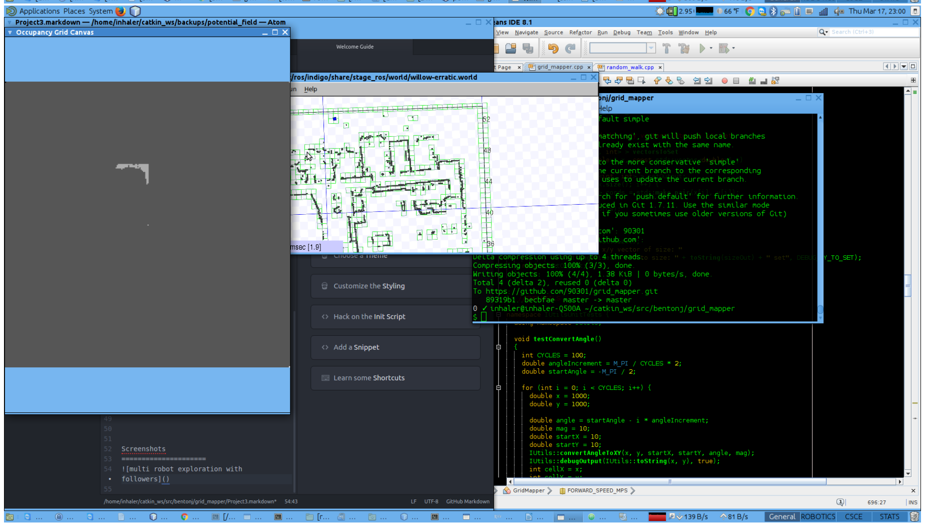
  const static double MIN_SCAN_ANGLE_RAD = -45.0 / 180 * M_PI;
  const static double MAX_SCAN_ANGLE_RAD = +45.0 / 180 * M_PI;
  const static float PROXIMITY_RANGE_M = 1;
  const static bool PLOT_LASER = false;
  const static bool DEBUG_PLOT_LASER = true;

  const static int STARTING_ANGLE = 180;
  const static int RANDOM_ANGLE = 20;

  const static int SPIN_RATE_HZ = 30;

  const static char CELL_OCCUPIED = 0;
  const static char CELL_UNKNOWN = 86;
  const static char CELL_FREE = 172;
  const static char CELL_ROBOT = 255;


protected:
  ros::Publisher commandPub; // Publisher to the current robot's velocity command topic
```


Applications Places System
Project3.markdown — /home/inhaler/catkin_ws/backups/potential_field — Atom
Occupancy Grid Canvas
Welcome Guide
Customize the Styling
Hack on the Init Script
Add a Snippet
Learn some Shortcuts
NetBeans IDE 8.1
grid_mapper.cpp random_walk.cpp
GridMapper FORWARD_SPEED_MPS
696:27 INS
139 B/s 81 B/s General ROBOTICS CSCE STATS
Thu Mar 17, 23:00

```
Screenshots
=====================
![multi robot exploration with
followers]()
```

/home/inhaler/catkin_ws/src/bentonj/grid_mapper/Project3.markdown* 54:43

```
fault simple

matching', git will push local branches
lready exist with the same name.

to the more conservative 'simple'
he current branch to the corresponding
 uses to update the current branch.

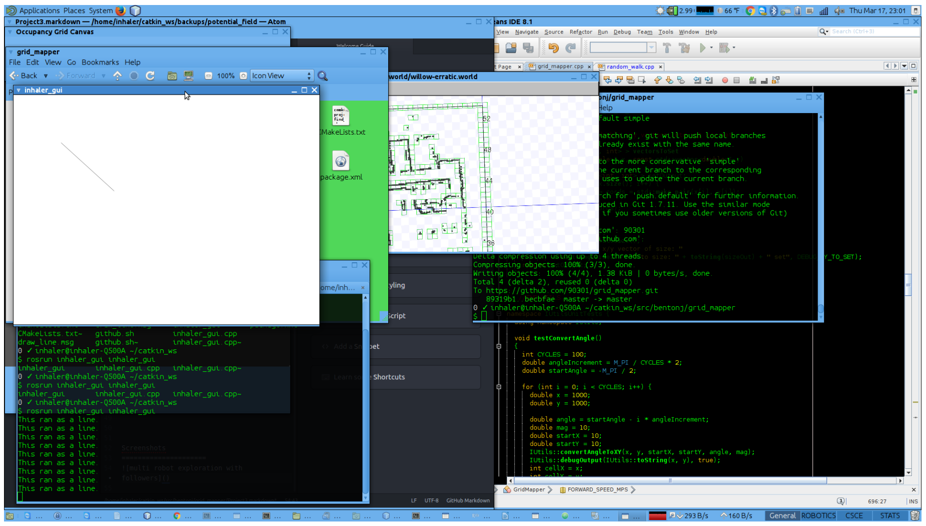
rch for 'push.default' for further information.
uced in Git 1.7.11. Use the similar mode
 if you sometimes use older versions of Git)

com': 90301
ithub.com':
Delta compression using up to 4 threads.
Compressing objects: 100% (3/3), done.
Writing objects: 100% (4/4), 1.38 KiB | 0 bytes/s, done.
Total 4 (delta 2), reused 0 (delta 0)
To https://github.com/90301/grid_mapper.git
   89319b1..becbfae  master -> master
0 ✓ inhaler@inhaler-Q500A ~/catkin_ws/src/bentonj/grid_mapper
$
```

```
  void testConvertAngle()
  {
    int CYCLES = 100;
    double angleIncrement = M_PI / CYCLES * 2;
    double startAngle = -M_PI / 2;

    for (int i = 0; i < CYCLES; i++) {
      double x = 1000;
      double y = 1000;

      double angle = startAngle - i * angleIncrement;
      double mag = 10;
      double startX = 10;
      double startY = 10;
      IUtils::convertAngleToXY(x, y, startX, startY, angle, mag);
      IUtils::debugOutput(IUtils::toString(x, y), true);
      int cellX = x;
```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Occupancy Grid Canvas
grid_mapper
File Edit View Go Bookmarks Help
inhaler_gui
MakeLists.txt
package.xml
world/willow-erratic.world
ans IDE 8.1
View Navigate Source Refactor Run Debug Team Tools Window Help
grid_mapper.cpp
random_walk.cpp
onj/grid_mapper
GridMapper
FORWARD_SPEED_MPS
Thu Mar 17, 23:01
General ROBOTICS CSCE STATS

```
CMakeLists.txt~   github.sh         inhaler_gui.cpp
draw_line.msg     github.sh~        inhaler_gui.cpp~
0 ✓ inhaler@inhaler-Q500A ~/catkin_ws
$ rosrun inhaler_gui inhaler_gui
inhaler_gui       inhaler_gui.cpp   inhaler_gui.cpp~
0 ✓ inhaler@inhaler-Q500A ~/catkin_ws
$ rosrun inhaler_gui inhaler_gui
inhaler_gui       inhaler_gui.cpp   inhaler_gui.cpp~
0 ✓ inhaler@inhaler-Q500A ~/catkin_ws
$ rosrun inhaler_gui inhaler_gui
This ran as a line.
This ran as a line.
This ran as a line.
This ran as a line.
This ran as a line.
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This ran as a line.
This ran as a line.
This ran as a line.
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    double angle = startAngle - i * angleIncrement;
    double mag = 10;
    double startX = 10;
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    IUtils::convertAngleToXY(x, y, startX, startY, angle, mag);
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