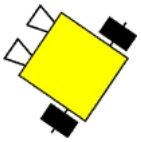
cis1.5/robotics-spring2008-azhar
robotics.edu—agents lab
Brooklyn College, CUNY



lab III.2: surveyor robot class [1], programmer defined functions

Name:

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information

- You will have one class period to work on this lab: Thurs MARCH 20. There may also be some extra time if needed.
- **The assignment is due at the end of class (HARD COPY) on MON MARCH 31**
- The assignment is worth **10 points**

programming assignment (TO BE DONE WITH A PARTNER)

- MY PARTNER'S NAME IS:
- After you get each program to work, write the code in the boxes provided. Partial credit will be given!
- **Demonstrate each working program for your instructor.**

[1]

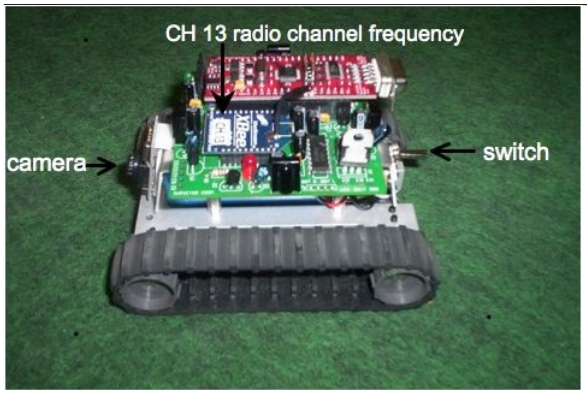
vocabulary

- Surveyor
- XBee USB Dongle
- text editor
- compile
- link
- command prompt
- `make` command
- `cd` (change directory) command
- class
- object
- member function

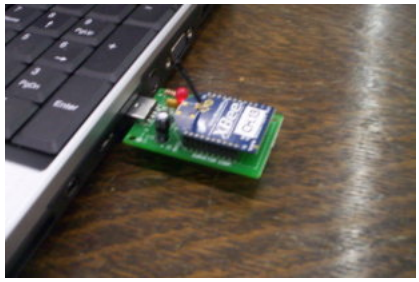
materials

Make sure you have all of the following materials before you start the lab:

- Surveyor robot
  - The Surveyor is a cute little tracked robot that communicates with a PC via a XBee USB dongle.



Surveyor robot



Ch13 XBee dongle

- c++ compiler, such as mingw (Windows) or g++ (Mac)
- codeblock, text editor, such as Notepad (Windows) or TextEdit (Mac) or pico (Unix)
- you must be in
  - `\dev\examples` directory in Windows
  - `/dev/examples` directory In Mac or Unix or Linux computer.
  - Please note that Windows computers use *back slash* (`\`) to separate directory (e.g., `\dev\examples`) while all other operating systems (e.g., Linux, Unix and Mac) use *forward slash* (`/`) to separate directory (e.g., `/dev/examples`)
  - use **cd** command in all machine to change directory. ask if you need help)

instructions

1. create your first program

- Enter the following program using a text editor:

```
#include "SVR.h"

#include <stdio.h>
#include <stdlib.h>

#include <iostream>
#include <assert.h>
using namespace std;


/* make a global Surveyor object called robot */
Surveyor robot (ADDRESS);


int main()
{

        robot.drive(50, 50, 100);

        return 0;
}
```

In your editor, make sure you save the file as **begin.cpp** in `\dev\examples\` directory!

2. dissecting the code

- `#include "SVR.h";`
  This line always needs to be included at the top of all programs writen for the Surveyor. Whenever you use a command in a program like `robot.drive(50,50,100);`, the Surveyor has to know what that means. The `includet...` line tells the program where to find a "library" of all the surveyor specific terms. Please note that this header is not part of standard C++ library. SVR.h is specially written for Surveyor robot.

- `#include <stdio.h>;`
  This line is required for standard input output

- `#include <stdlib.h>;`
  This header defines several general purpose functions, including dynamic memory management, random number generation, communication with the environment, integer arthmetics, searching, sorting and converting.

- `#include <iostream>;`
  This header is an object-oriented library that provides input and output functionality using streams.

- `#include <assert.h>;`
  This header defines one macro that can be used as a standard debugging tool.

- `using namespace std;`
  This line lets you use cout and cin without additional syntax (e.g., std::cout).
- `Surveyor robot (ADDRESS);`

  - **Creating class object:** This line creates an **object** of class type `Surveyor` called `robot`. You may use this object (e.g., **robot**) to send commands (e.g., **(**drive(50, 50, 100)) to your robot.
  - **Global declaration:** This is a **global** declration and can be used by the *main()* program and as well as your defined functions in this program.

- `int main ( )`
  This line needs to be in every program. This denotes the **main function**. This is what will be run when the program starts.

- `{`
  This is a beginning **curly bracket**. Everything between the beginning (`{`) and ending (`}`) curly brackets is part of `main`. Curly brackets are used to delineate not only the main but also the function and blocks within a program.

- `robot.drive(50, 50, 100);`
  - `drive()` is a **member function** of `Surveyor class`.
  - **Function Parameters:** `drive(int left, int right, int duration)` member function of `Surveyor` class takes three **integer** parameters. For example, in our `drive(50, 50, 100)` member function call:
    - first parameter asks the robot to set its left track speed at 50 (the first 50)
    - second parameter asks the robot to its right track speed at 50 and
    - third parameter asks the robot to let it run for 100 hundreths of a second or 1 second.
  - **Creating class object:** Usually, you need to have class object to call member function. For example,
    `Surveyor robot (ADDRESS);`
    created an **object** called `robot` .
  - **Calling member function:** Use the `dot`operator (.) to call your member function *objectName.MemberFunction()* (e.g., `robot.drive(50, 50, 100);`)
  - A **member function** (e.g., `drive()`) is an entity in an object-oriented program that contains instructions for the object (e.g.,`robot`) to do something, like perform an action (e.g., move) or set the value of a variable (data field).
- more about **drive** member function

  - The `drive()` member function of the Surveyor class is very useful for driving your surveyor robot.
  - The left and right track speeds can be in the range -128 to +127.
  - Use negative left or right track speeds (e.g., -50) to go in opposite direction.

  - The duration is in the range 0 to 255.
  - A duration of 0 means until the next drive command. The duration parameter is best for precise control, any value longer than a few hundredths of a second is probably best done by using a duration of 0 and having your PC do the timeing. Examine the sleep functions available on your system.

3. **compile your program**

- From the Windows command window or the Mac terminal window, at the command-line prompt (`prompt>`), type:
  `prompt> make begin`
  This will compile and link the program.
- If there are errors in your program code, fix them and then try compiling and linking again—until the program compiles and links without any errors.

4. **run your program**

- Make sure the **XBee dongle** is be same channel as your robot and is connected to your computer's USB port.
- Connect it to your computer's USB port (ask if you need help finding it).
- The Surveyor must be turned on.
- On Windows, at the command-line prompt (`prompt>`), type:
  `prompt> begin`
  or on the Mac (or Linux or Unix) terminal window, at the command-line prompt (`prompt>`), type:
  `prompt> ./begin`
  This will run your program and send commands to the robot.
- What did your robot do? Is that what you expected? Write your answer below.

- **troubleshooting**
  - If you have trouble, check these things:
    1. The Surveyor must be turned on during communication.
    2. LEDs on the robot and dongle should be on.
    3. the `make` command should be in your **path** (ask if you need help).
    4. you should be in the right directory:
       - On Windows:
         - `\dev\examples` directory in Windows.
       - On Mac:
         - `/dev/examples` directory In Mac or Unix or Linux computer.
    5. Make sure the **XBee dongle** is be same **channel** as your robot and is connected to your computer's USB port.

5. **modify the program**

- Now change the program to make your robot go backwards for 4 seconds and then stop.
- **Edit** the program using your text editor, **compile** it, **run** it again to **test** it.
- Repeat this process until it works!

6. **programming challenges**

- Complete as many of the following programs as you can.
- After you get each program to work, demonstrate your working program for your instructor.

- Make sure that you save the program as **begin.cpp** and follow the procedures as described earlier to test your program.

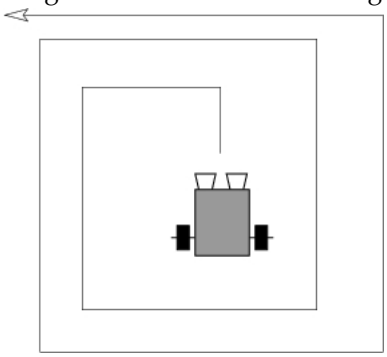
(a) Program the robot to go forward for 2 seconds and then go backward for 2 seconds and then stop. Is it back where it started from? (Hints: use negative left or right track speed to move the robot in opposite direction)

(b) Make your robot to select a random direction and travel a random distance in that direction (hints: use rand and srand functions).

(c) Program your robot to go in a square.

- Write a function called `square()` that is designed to make the robot go in a square
- Write a main() function that does the following:
  - Call the `square()` function

(d) Program the robot the robot to go in a spiral pattern like this:



(e) Program your robot to go in a square, triangle, circle and spiral.

- Write a function called `square()`,`triangle()`, `circle()`, and `spiral()` which are designed to make the robot go in a square, triangle, circle and spiral respectively.
- All four functions have no parameters and return `void`
- Write a main() function that does the following:
  i. add five letters to the set of user commands that will allow the user to tell the surveyor to go in a square (or triangle or circle or spiral). Use the following letters:

Q	quit the program
s	make the robot go in a square
t	make the robot go in a triangle
c	make the robot go in a circle
p	make the robot go in a spiral

  Note the distinction between upper and lower case letters!
  ii. each user's choice will call the corresponding function to make the robot move according to user's choice.