RET | ENGINEERING
TEXAS A&M UNIVERSITY
Research Experience for Teachers

A guardian robot that patrols and monitors our home

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[Engineering and Technology]

Abstract

Robot can serve human society in many way. Domestic service is a very important application since we expect to blend the robot into our daily life. Home security surveillance is the one that robots can easily do for us when we are not home. The challenge of this research project is two-fold. First, the robot must be able to move freely and patrol the area autonomously. Second, it must be able to detect the ambient anomaly and blow the whistle to its owner or operator in a distant site supposedly. This requires the navigation algorithm to integrate the motion control and sensing capability that exemplifies the need of mechatronic knowledge to implement this project.

Research Objectives

Robotic applications are tremendous. One of these tasks is to use robot for remote surveillance or patrolling the environment. The mobile robot can help household owners to safeguard their houses while they are away the premises. In order to accomplish his task, the robot must be able to move around in the environment and ability to sense the ambient condition. This kind of domestic service robot can be remotely controlled or totally autonomous in nature. Either modes requires wireless communication link to the outside world. In this project we try to build the robot which can be controlled on demand or can go autonomously on certain mission. The first goal is to ask the robot to check the lights of a room to see if it is still left on. If it is on, it will say “light” and send a signal to warn the house owner. This task can be scaled up to higher level such as tracking the light source or voice source by recording the scanning positions. From educational point of view, we use popularly available LEGO Mindstorms microcontroller as basic robotic platform for our experiment since it comes with built-in communication capability such as Bluetooth. We also investigate other possibility to set up communication link such as WiFi, X-Bee,..etc. The educational value of this project is threefold; one is to implement the concept of learning by doing; the other is to synergize the scientific concepts with the hand-on technologies, and most of all, to develop the students' sense of creativity.

Methodology

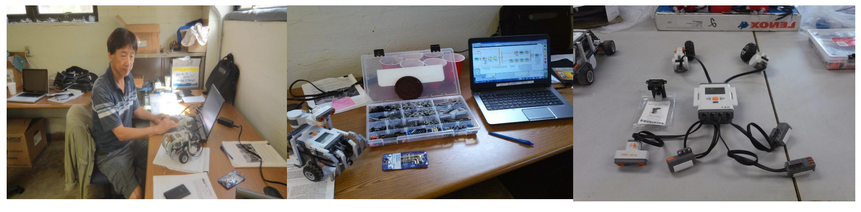
In this lesson, students will learn how to build the robot servant by using LEGO parts and NXT Brick microcontroller. They will apply their knowledge of electronics, mechanics, and computer programming skill to control the motion of robot. They will learn how to troubleshoot the hardware errors and debug the software logic mistakes. They will learn the rest of functions such as sensing and communication in the following lessons.

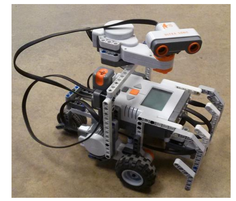
In the first lesson (including lecture and lab), students will learn how to build the robot servant by using LEGO parts and NXT Brick microcontroller. They will apply their knowledge of electronics, mechanics, and computer programming skill to control the motion of robot. They will learn how to troubleshoot the hardware errors and debug the software logic mistakes.

In second lesson, they will learn the rest of functions such as interaction between sensor signals, actuators, and the controlling programs. They need to develop the program code in order to accomplish each task or mission described in the task function block. Test the code and debug the erroneous logic algorithm.

In last lesson, they have to simulate the scenario such as a room with light switch that can be turn on and off. They have to place the robot and the controlling device (a host computer or smart mobile phone or tablet) in separate rooms, and then set up the communication capability between the control device and the robot. The measure of effectiveness is to see if the control device can receive the signal "1" as "yes, light is on" or signal "0" as "no, light is off". The communication links between robot and controllers may be Bluetooth, X-Bee, WiFi. They can be controlled from PC or mobile phones, or tablets.

The lessons are followed by hand-on activity which requires students to implement the robot hardware as well as software. The assessments for learning outcomes depend on Pre-lesson test, Post-lesson test, and physical performance test. The format of these test is listed in Lesson and Activity module.





Results and Conclusions

Video clips:

Max in action

Remote control via phone

References

LEGO Mindstorms NXT 2.0 User’s guide
The art of LEGO Mindstorms NXT-G Programming, by Terry Griffin
http://www.lego.com/en-us/mindstorms/support

S. B. Niku, “Introduction to Robotics: Analysis, Control and Applications, John Wiley & Sons, 2011.

Norman Nise, “Control System Engineering”, 5th Edition, John Wiley &Sons, Inc. 2008, ISBN 978-0-47179475-2.

M. Mazidi, R. McKinlay, and D. Causey, “PIC Microcontroller and Embedded Systems”, Prentice hall, 2007, ISBN 0-13-1194046