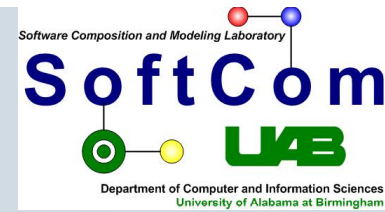




Voice Activation of a Robotic Vehicle

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ABSTRACT

This research developed a Java-based program that interacts with a speech recognition engine to control a Lego Mindstorms NXT robot. The robot's movement is controlled through the transmission of voice commands to the robot. To accomplish transmission of voice commands to the NXT for execution, the voice commands were parsed and the appropriate signals were sent to the NXT via wireless communication using Bluetooth. The primary research focused on using Bluetooth for the interaction of a desktop PC that understands voice commands with the NXT robot.

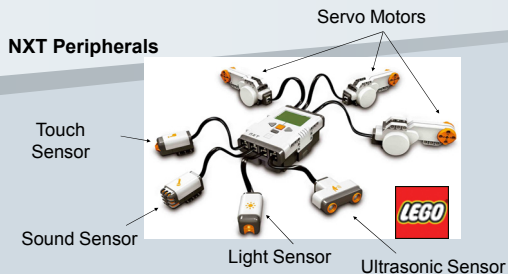
Proper downloading and installation of several software applications (e.g., Java speech recognition engine and special development tools to allow software written in Java to be downloaded to the robot), proper assembly of the Lego Mindstorms NXT robot, and an understanding of the Java programming language were required. These tools were necessary for the creation of a program for the movement of the robot as well as a program for speech recognition and Bluetooth implementation. The NXT receives the voice commands defined in the program via Bluetooth and executes them, demonstrating coordinated control between a robot and a human who issues commands by voice. This project was an initial investigation into new ways that humans may interact with autonomous vehicles.

VEHICLE CONSTRUCTION

The robot constructed for this project is a simple vehicle that uses two motors to manipulate movement. The code for controlling the robot's motors and Bluetooth was written in Java using leJOS, a tiny Java-based operating system for LEGO Mindstorms platforms.



The robot is a product of LEGO. The LEGO Mindstorms NXT robot was made available to consumers in July 2006. The NXT has many unique functions and capabilities, including Bluetooth connectivity; light, reflectivity, ultrasonic distance, sound, and touch sensors; three motors; a 32-bit processor; and 256 Kbytes of Flash memory.

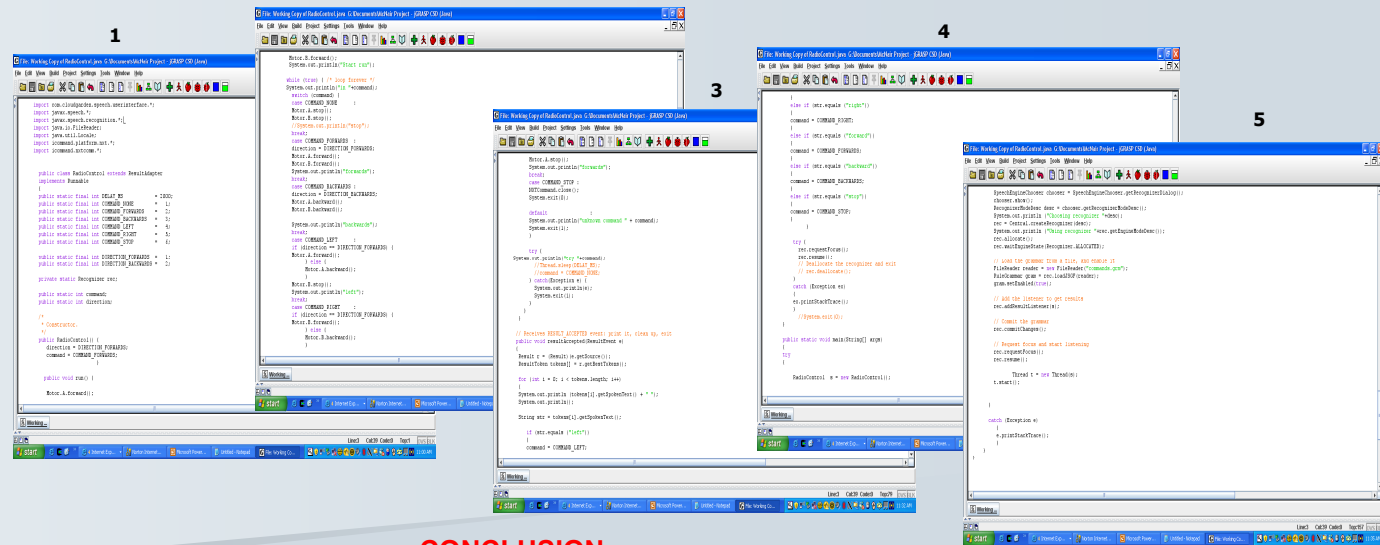
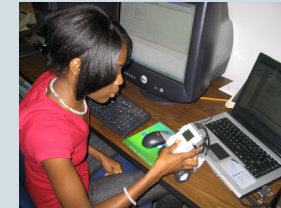


OBJECTIVES

This project incorporates the use of several software applications. The CloudGarden Speech Recognition Engine and Java Speech Application Programmable Interface (JSAPI) were used for the recognition of the user's commands. These commands are outlined in a grammar file imported into the speech recognition code. To activate the Bluetooth connection, leJOS and iCommand are used. Also, leJOS is used for the movement of the robot.

SOFTWARE CONTROL

1. Imports the CloudGarden Speech Engine, JSAPI, and iCommand for the connection of NXT and PC Bluetooth; creates the class and class constructor.
2. Activates the robot's motors for each command; placed in a while loop for continued access to the code while condition is set to true.
- 3 & 4. When a word is recognized, the result is stored as a token and matched with the corresponding command; deallocates the recognizer.
5. Creates, shows, and allocates the speech recognizer; loads the grammar file; recognizer listens for the user's voice.



CONCLUSION

Voice control of the robot was successful and Bluetooth was proven to be an efficient means of sending signals from the PC to the robot. The robot received the voice commands from the PC via Bluetooth and movement occurred according to the commands spoken by the user. Problems did arise with finding a way for the speech recognition engine to continuously recognize the user's words and getting Bluetooth set up and working properly in the program. These problems were eliminated with careful observation and numerous code refinements. Combining all three programs used for this research project into one working program was a major challenge also. The NXT and Bluetooth connection had to be reset on numerous occasions; however, this did not have an effect on the outcome of the investigation.

Continued investigation in this area can open the door to many new possibilities and discoveries. For example, similar vehicles could be used to navigate through disaster areas to locate survivors or to explore places that are dangerous for humans. Even more amazing, imagine being able to control an automobile by simply speaking to it. The discovery of new ways that humans may interact with autonomous vehicles will change the world as we know it today.

REFERENCES

1. <http://lejos.sourceforge.net/>
2. <http://www.cloudgarden.com/JSAPI/index.html>
3. <http://java.sun.com/>

ACKNOWLEDGMENTS

Dr. Jeff Gray
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