Mobile Robot Control Using Voice Commands

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Abstract: *This paper discusses a remote control system for a mobile robot using voice commands sent wirelessly over a network to a mobile robot.*

1. Introduction

The idea that human-controlled, mobile robots will one day be common household items is very prevalent throughout our society. This dream is not very far-fetched, but before it becomes a reality, several advancements in mobile robot design and control must be realized. One of the single most important advancements that must be made is the ease and intuitiveness of control.

Most of the operational mobile robots today are controlled using a complicated set of software commands and a hardware device to enter these commands such as a keyboard or joystick. The average person may have a hard time learning how to use these methods of control. One promising field of study for making control easier for the average person is the field of speech recognition. There has been research done in this field that allows people to literally talk to devices in order to control them. There has even been research in the way of using a cell phone to communicate voice commands to a robot[1].

The goal of this paper is to present a simple control system that uses speech recognition to wirelessly control a mobile robot. The commands found in this control system are extremely intuitive words such as STRAIGHT, REVERSE, RIGHT, and LEFT. With a simple and intuitive control system that uses the human voice as input, the authors believe that anyone can easily control a mobile robot.

2. Speech Recognition

In order to realize a voice controlled robot, there must be some way to recognize the commands coming from a voice. Robust software libraries have already been developed for voice recognition. This paper uses Carnegie Mellon University's Sphinx-4 voice recognition software. The Sphinx-4 libraries are used because they were developed in Java and are consequently highly mobile. They can be compiled and run on any computer [2].

A Sphinx-4 demo program was modified to realize the voice control software. The voice control software is used to recognize and decode certain keywords from the voice of the user [3] and translate those words into commands that are then sent over a network to the robot. **Fig. 1** shows the robot in the global reference frame.

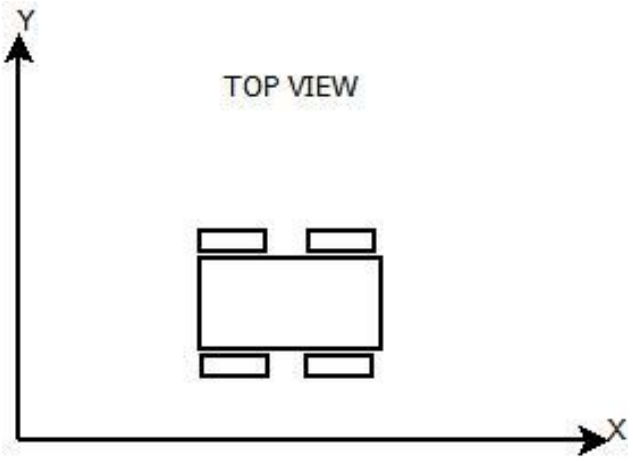


Fig 1 – Robot in global reference frame

Fig 2 shows a list of the voice commands that are recognized and used by the robot and the corresponding actions that the robot takes.

Command	Action
Straight	Robot moves in the positive x direction.
Reverse	Robot moves in the negative x direction.
Left	Robot rotates around its center of gravity in the counter-clockwise direction
Right	Robot rotates around its center of gravity in the clockwise direction.
Faster	Robot increases the angular velocity of its wheels.
Slower	Robot decreases the angular velocity of its wheels.
Halt	Set angular velocity of wheels to zero.

Fig 2 – List of voice commands

3. Wireless Operation

In order for the mobile robot to be truly mobile, it must be un-tethered to its controller. For this purpose, a wireless network was used to transmit commands to and to receive feedback from the robot. The wireless network consisted of a control computer from which the commands were sent, a separate computer on-board the robot, and a router that provided the wireless connection between the two computers.

The voice control program uses a socket that uses UDP packet framework to send the commands that it interprets over the network to the robot. This framework allows for very fast and efficient transmission; however, it is unreliable and the risk of packet loss is high. To counter this risk, a sequence number is attached to each packet when it is sent, so the receiving computer can determine if a packet was lost. **Fig 3** shows the layout of the network and its interfaces.

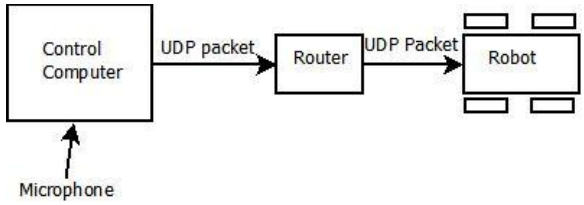
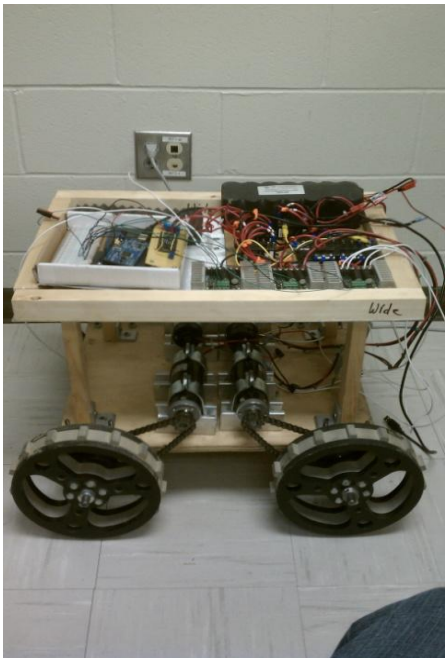


Fig 3 – Network layout

4. Drive Platform

The drive-train for the robot is a four wheel differential drive platform. The platform consists of four motors, two motor-controllers, and an Arduino microprocessor. The Arduino receives the commands from the robot's on-board computer and sends those commands out to the two motor controllers.



5. Conclusion

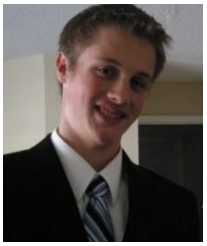
In this paper a voice controlled mobile robot was presented as an intuitively controlled household device. The voice controls used are simple enough for anyone to understand and use. We believe that one day voice controlled robots like the one presented in this paper will be a part of everyday life.

6. References

[1] T. Kubik, M.Sugisaka "Use of a cellular phone in mobile robot voice control" SICE 2001, Proceedings of the 40th SICE Annual Conference, 2001.

[2] P. Lamere, P. Kwok, W. Walker, E. Gouvea, R. Singh, B. Raj and P. Wolf "Design of the CMU Sphinx-4 Decoder," Tech. Report, Mitsubishi Electric Research Laboratory, 2003.

[3] P. Lamere, P. Kwok, W. Walker, E. Gouvea, R. Singh, B. Raj and P. Wolf "The CMU Sphinx-4 Speech Recognition System," Sun Microsystems Laboratories, USA, Carnegie Mellon University, USA, Mitsubishi Electric Research Laboratory.



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