Autonomous Tennis Ball Collector

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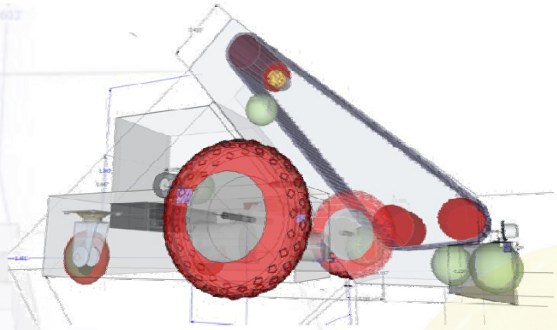
Description

The autonomous robot consists of two geared motors, two ultrasonic sensors, two encoders, two six-inch wheels, one Arduino microcontroller, one 2x25 amp RoboClaw motor controller, one motor for the belt, one 44-inch sandpaper belt, two 6V batteries and one custom-designed sheet metal chassis. The autonomous robot is a tennis ball collector that randomly searches for tennis balls. When the power switch is turned on, the robot begins to roam for tennis balls by controlling the two front geared motors connected to six-inch wheels. The L-shaped design of the belt displayed on the figure to the right shows how the tennis balls are collected.



Robot Before Programming/Wiring

Project Objectives

The main objective of this project is to develop an autonomous robot that will retrieve balls around a tennis court. It is expected to avoid any obstacles on its path and collect the balls by using a conveyor belt attached at one end of the robot.

The immediate and most logical implementation of a system with such capabilities would be the adaptation of robotic vacuums like the iRobot Roomba. The motivation behind this work is the idea of avoiding the exertion of unnecessary energy in picking up all of the tennis balls on the court after or between practice.

The implementation of this project was accomplished with the use of an Arduino microcontroller, dual motor controllers and ultrasonic sensors. The decision was based on the costs and the simple programmability of all the components together. If professional leagues, were ever going to use this sort of technology, then this project could serve as a stepping-stone to more advanced tennis ball collectors.

Microcontroller and Motor Controller

The most important component of the robot is the Arduino 2560 Mega microcontroller, which serves as the robot's brain. The Arduino has 54 digital input/output pins and 16 analog pins. It runs on 5V which can be delivered to the microcontroller via the voltage regulator on the motor controller. The Arduino is also open sourced and can be programmed in C.

In order to control the robot's motors a RoboClaw motor controller was implemented into the system. The RoboClaw 2X25 Amp, purchased from robotmarketplace.com, is an efficient, versatile, dual channel synchronous regenerative motor controller. This means that whenever the motors are slowing down or braking, the batteries are being charged. It supports dual quadrature encoders and can supply two brushed DC motors with 25 Amps of continuous current and a 30 Amp peak. Dual quadrature decoding allows for greater control of speed and acceleration. It automatically maintains a speed even if the load increases and has a built in PID routine for use with an external control system.

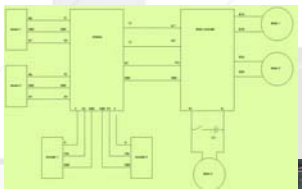
The RoboClaw is also easy to control with several built in modes, all of which are controlled by the on board dip switches. It can also be controlled from the Arduino and it is equipped with screw terminals for easy mounting. Another main reason for choosing this controller was the fact that the amount of current it could handle was compatible with the wheel motors.

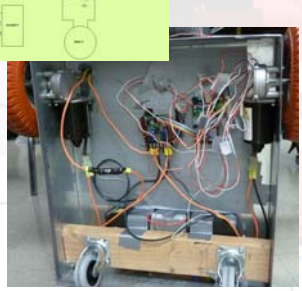
Final Product

Functionality

The autonomous robot is powered by two 6V batteries connected in series. The RoboClaw 2x25 amp motor controller regulates the drive motors by modulating the rate of current coming out of the batteries. The Arduino microcontroller holds the programming code for the project, which controls both the ultrasonic sensors and encoders. The encoders allow the speed of the drive motors to be adjusted, so that both motors operate at nearly the same speed. This allows the robot to move in a linear path. The sensors send out ultrasonic pulses in front of the robot which measure the distance between it and any obstacle by timing how long it takes for the pulses to bounce back from the object. This data is then fed into the microcontroller and the programming then tells the motors to change direction depending on the location and distance of the obstacle. The tennis balls are collected by the L shape design of the conveyer belt. When a tennis ball comes into the base of the belt it is compressed between the belt and the ramp allowing it to roll up until it is dropped into the collection area.

Schematic and Robot's Underside





Conclusion

Over all the project was successful. The robot functioned as it was designed to. It roamed a closed area and gathered as many balls as it could while avoiding walls and other obstacles. Though it was programmed to roam randomly, the encoders did serve to correct for any straying while it traveled in straight lines. The accurate measurement and design of the robot, with aid from Google Sketchup ,allowed for the chassis and belt system to be built once and without need of modification. Despite two motor controller failures the project was completed on time and functioned as a proper autonomous tennis ball collecting robot.