POKER BOT

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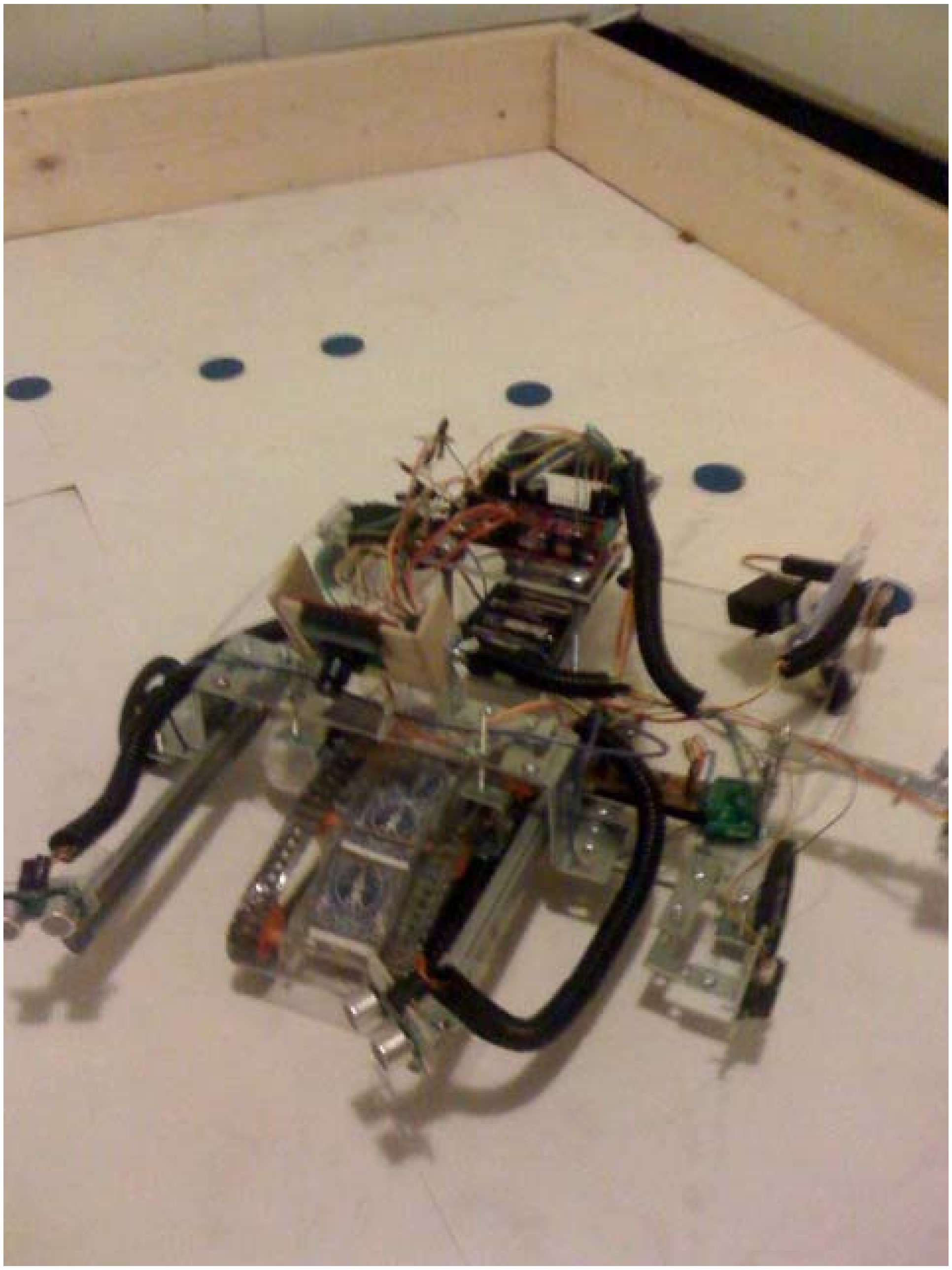
Poker Bot is an autonomous robot capable of replacing the dealer of a poker game. It moves around the table to collect cards that have been used, and once this task is completed, it goes to the next behavior where it deals cards.



Poker Bot

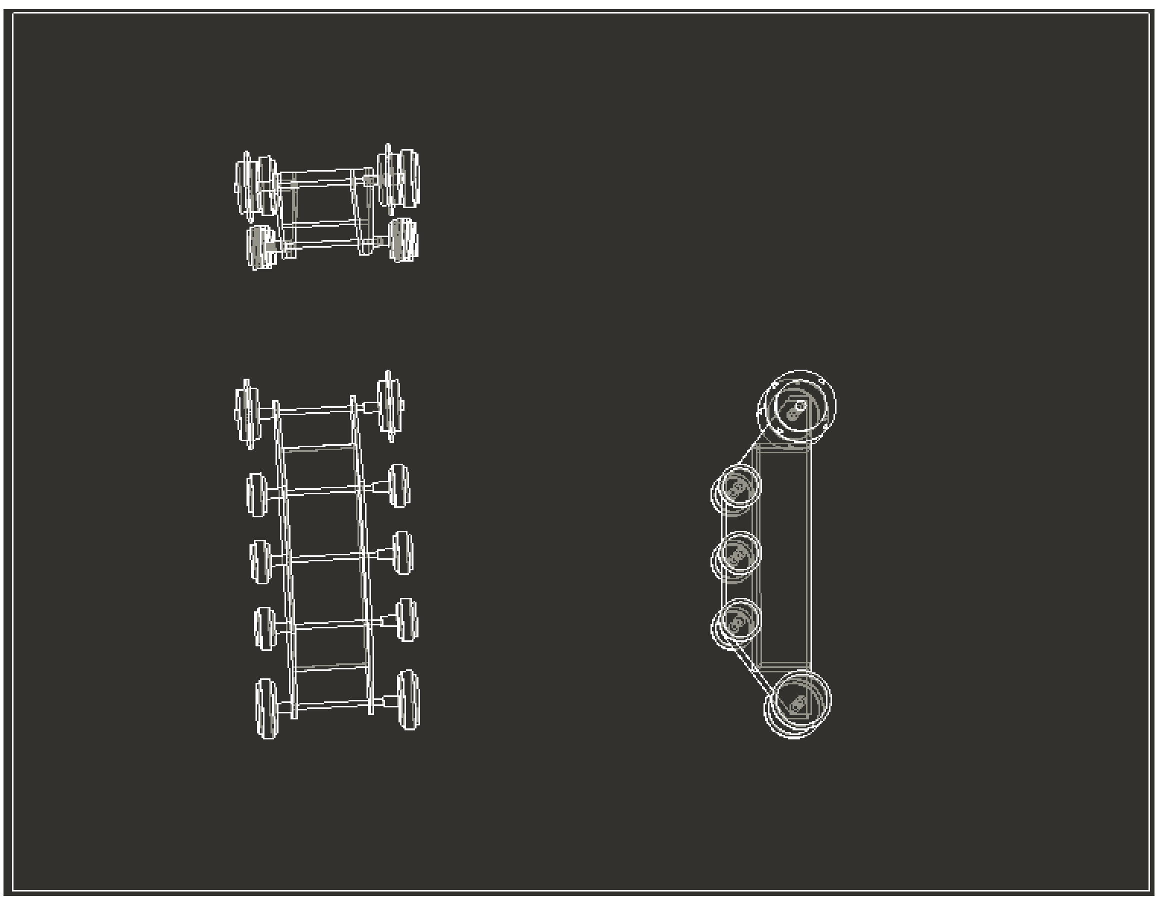
Platform:

Poker Bot's platform is a two drive wheel design, with two casters in the back for necessary support. The two drive wheels are independent from each other, so the robot can turn in place if one motor is driven forward, while the other one is driven backwards. The platform is quite large because it needs to hold such an array of things. These components include:

Sensors: 4 sonar, 2 IR, 1 CMU cam
Maveric IIB board
LCD
Batteries
Wheels, motors, motor controller and diode circuit
Card picking up device: Conveyer/vacuum chamber, vacuum, hose, and shelf for cards.
Card dealing device: dealing shoe and eraser for dealing.

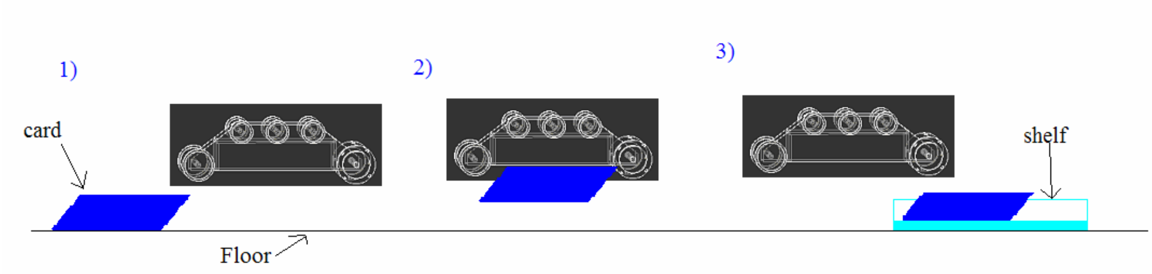
Function:

Card picking up device:
This is the most complex component of Poker Bot's assembly.



Design of Poker Bot's card picker upper. (does not include vacuum or treads)

This is a mechanical system that uses friction and suction to complete its task of gathering cards off of a surface without touching the surface. A tread system was designed with a chamber in the middle of it. A solid belt, with few holes cut in it, is put around the tread system and held taught. A vacuum is attached to the chamber inside by a hose (not shown). As the treads move (through power from a servo) the belt rotates, as do the holes cut in the belt. As the holes move over the vacuum chamber, air is sucked up. When this system is placed about a half inch over a surface, it can pick 1 or more playing cards which are laying face down. The cards are drawn towards the robot by the moving belt, and the suction from the vacuum keeps them "glued" to the moving belt. The cards are then dropped on to a shelf where they can be collected by the user.

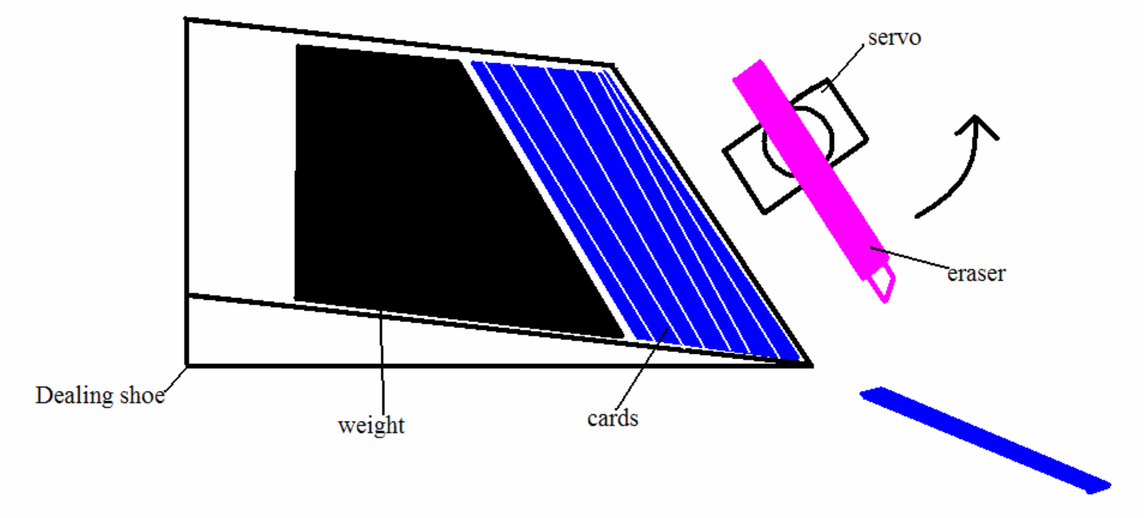


Card picker upper in action

This method of picking up cards was used because it was emphasized that the cards and the table could not be harmed in any way. Although this is probably an over-complicated design, it achieves its purpose, and looks cool in the process.

Card Dealing Device

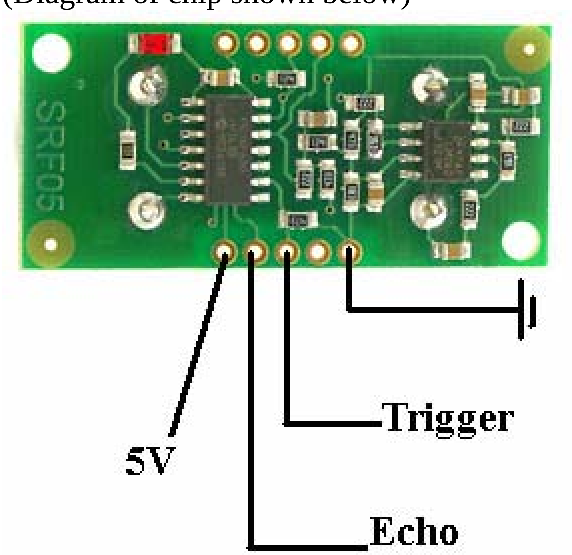
The card dealing device utilizes a dealing shoe to deal out one card at a time. An eraser was attached to a continuous rotation servo. The flexible eraser tip is perfectly aligned with the dealing shoe so that every time it rotates around it pulls a single card out of the shoe. This allows any amount of cards to be dealt with ease.



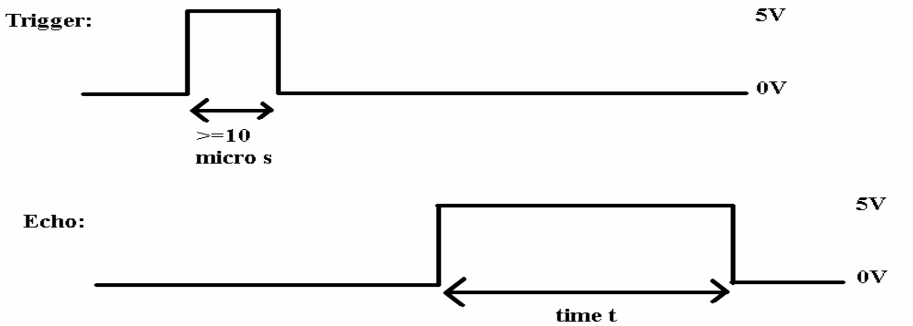
dealing device

Sensors:

Sonar:
I am using 4 SRF05 sonars on my robot for basic obstacle avoidance. Each sonar operates the same way. There is a 5V and ground pin so the sonar can receive power. There is also a trigger and an echo pin. The Trigger receives a signal from output from the maverik board. The echo pin is output from the sonar to the maverik board. (Diagram of chip shown below)



How it works:



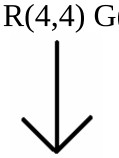
The board sends a 10 micro second pulse to the trigger pin. This sends the trigger pin to high for a small fraction of time. When this pin goes to high it sends out a sound wave for that amount of time. The echo pin stays at OV and waits for the return of the trigger sound wave. Once the Echo pin "Hears" the sound return it goes to 5V for the duration of the sound wave. The time it took for the sound wave to return, time t, is proportional to the distance the sonar is away from an object.

IR:
I am also using IR's for wall following. IR's simply return a value for the distance it is from an object. By mounting an IR in the front of the robot, and one in the back, the robot can adjust its movement according to how far away it is from the wall it's trying to follow. Unfortunately IR's have an inherent flaw when something is closer than 3", so to offset this error, a sonar is used to find "where the garbage values begin", and these values are discarded.

CMU Cam:
I am also using a CMU cam to process images and "track" the red cards so that the robot heads in the correct direction. The CMU cam runs on 12V, while the Maverik board runs on only 5V, therefore RS-232 communication is necessary for these two devices to work together. Basically, the RS-232 assigns a logical one or zero in the correct voltage of the device so that they can "talk" to one another.

The camera itself contains 356 columns and 292 rows of light sensitive cells. Each of these cells is sensitive to a particular color, either red, blue, or green. The amount of color that each cell "sees" is proportional to the voltage they output. These voltages are converted to numbers between 16 and 240 for each cell. The camera processor takes values from two rows to generate each output line. An example of how the camera processes data is shown below.

Row 1: B(1,1) G(1,2) B(1,3) G(1,4) B(1,5) G(1,6) ...B(1,355) G(1,356)
Row 2: G(2,1) R(2,2) G(2,3) R(2,4) G(2,5) R(2,6) ...G(2,355) R(2,356)
Row 3: B(3,1) G(3,2) B(3,3) G(3,4) B(3,5) G(3,6) ...B(3,355) G(3,356)
Row 4: G(4,1) R(4,2) G(4,3) R(4,4) G(4,5) R(4,6) ...G(4,355) R(4,356)

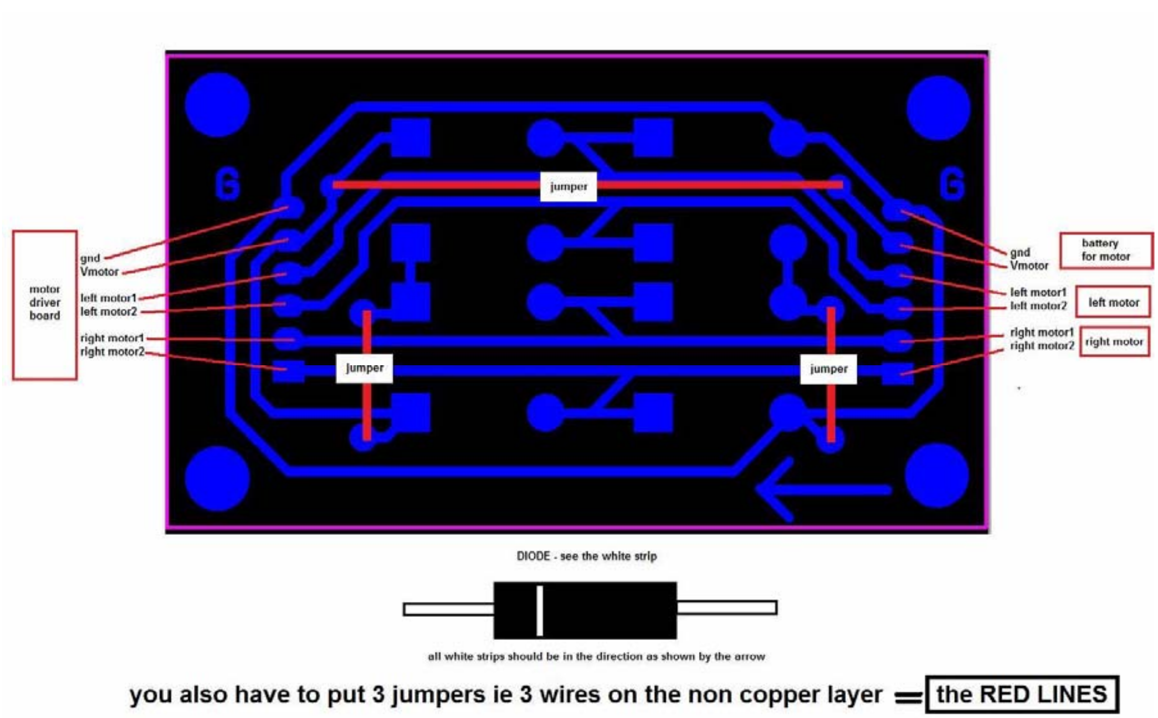


Row 1: [R(2,2):G(1,2):B(1,1)] [R(2,4):G(1,4):B(1,3)] ...
Row 2: [R(2,2):G(3,2):B(3,1)] [R(2,4):G(3,4):B(3,3)] ...

The camera also has the ability to track objects. To accomplish this task, the user enters a range of values for the color of the “tracked” object. The camera proceeds to mark each pixel that is within this range, and finds the topmost, side-most, and bottommost pixels that fall in this range, and makes a bounding box around them. As the camera takes more frames, and the object moves, the bounding box will move with it. It is in this fashion that objects can be tracked.

Circuits:

All the wiring was pretty straight forward. The only truly complicated circuit that needed to happen was for the drive motors. I had only bought a single opto-isolator, and it turned out I needed three. So instead of ordering more, and creating additional boards, I got a diode board T-teched, and attached the motors to this instead. It has the same general purpose of the opto-isolators, but is MUCH SIMPLER! I recommend to anyone who is taking this class in the future to use this method.

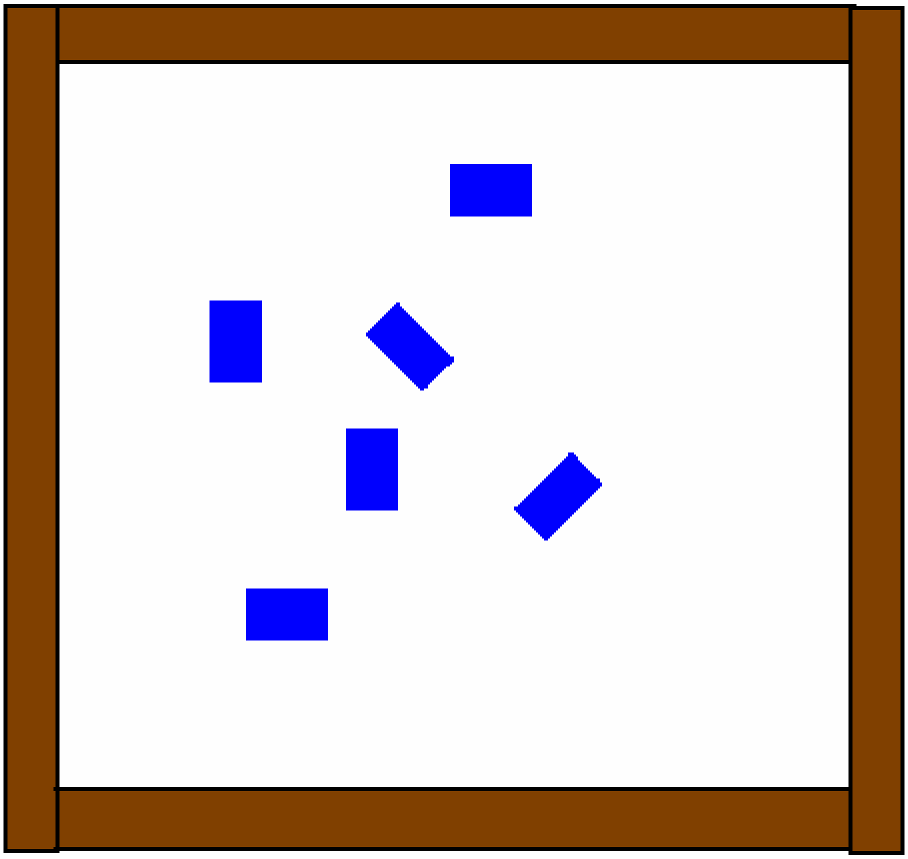


*Diode board to control motor current. Created by **Subrat Nayak.***

Behavior:

Poker Bot has two distinct behaviors.

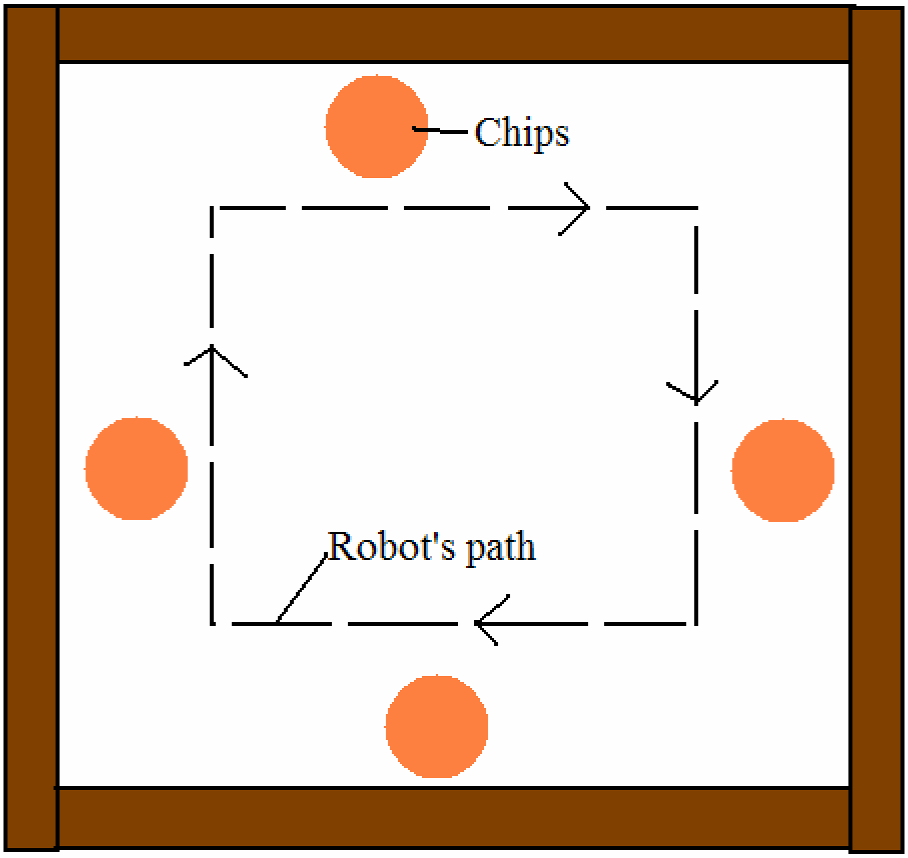
1) Finding cards:



Poker table with cards scattered on it

The first behavior is to find the cards. At the end of every poker hand, cards lay scattered over the table. First, the poker Bot activates its vacuum and conveyer belt system. Poker Bot then uses its CMU cam to track the blue cards that are scattered over the table, and drives over them. As this happens, the cards are picked up by the card picker upper, and placed on a shelf below the robot for easy retrieval. Poker Bot continues this behavior until a certain amount of time elapses. Poker Bot does this while running obstacle avoidance, so that it doesn't hit walls.

2) Dealing cards:



Poker table with dealing chips

The robot goes around the table in a clockwise rotation, and follows the wall by keeping away a certain distance. To follow the wall it uses two IR's in conjunction with a sonar to eliminate the errors inherent in the IR sensor. Every time it passes by a dealing chip, it activates the card dealer and deals a card. It continues around the table twice, so that every player receives two cards.

Problems to Overcome:

During the day of media presentation, when my robot was to be completed, it failed to complete its task of collecting cards and dealing them.

First problem: Make the robot move.

It seemed that once I actually put all of the components on the robot, that the current motors I was using to make it move around the table had an inadequate amount of torque to actually move the robot. To fix this, new motors needed to be bought, and made to fit on to the existing robot platform.

Second problem: Card Picker Upper failure.

During the demonstration of the card picker upper, it failed to complete its task of picking up cards. Before the demonstration I had charged the vacuum to its full capacity, making the suction stronger than I had originally intended. It sucked so hard that it actually restricted the servo from rotating the treads at all! To fix this I need only to cut more holes in the conveyer belt system so that more air can travel through. This will even increase the number of cards that it can successfully pick up.

Third problem: Wall following.

IR's have an inherent problem where when they lie within three inches of something they return values that are inaccurate. Because of this, and other issues, accurately following the wall around the poker table proved to be more difficult than it was first assumed. By placing a sonar in line with the IR's, the beginning and end of the garbage values could be calculated, and accurate wall following can be obtained.

I will fix these three problems in a timely fashion, and will proceed to test lots of times, until Poker Bot runs in the proper fashion.