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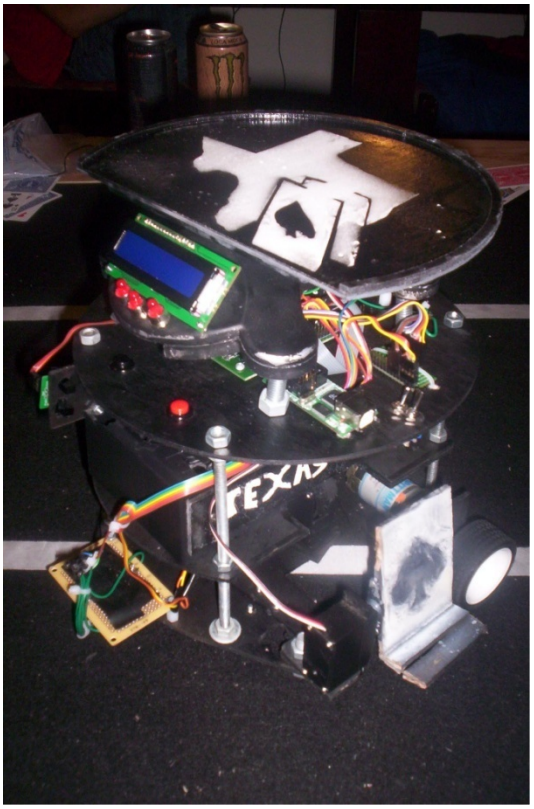
Written Report 2



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Abstract

My proposed robot, Texas Draw, purpose is to basically replace all the function of a Texas Hold'em style poker dealer. Thus Texas Draw's duties will be the following:

- Shuffling cards
- Dealing and flipping cards
- Taking bets
- Keeping track of all bets, raises, side pots, and folds.
- Distributing Winnings
- Declaring winner of game

Texas Draw will do these tasks with the help of these sensors, motors and other electronics:

- **4 IR sensors** for advanced line following and intersection detection (there will be an intersection on the playing mat on each possible player location.)
- **1 Break sensor** to detect when cards are folded (they are placed into a card slot)
- **2 Bump sensors**, 2 for a button to interact with Texas Draw
- **1 Force gauge** taken from the hacked food scale to measure the amount of poker chips in the pot (which is located on top of the robot)
- **1 LED screen** to interact with the players
- **3+2 motors**, 2 motors for robot movement, 1 for dealing cards + 2 motors that are in the hacked card shuffler being used to shuffle cards.
- **1 servo**, For working the card flipper

These electronics and motors combined with careful design and extensive programming Texas Draw could readily replace the Texas Hold'em dealer in both casual games and tournaments.

Executive Summery

Texas Draw's main purpose is to alleviate the inconveniences of shuffling dealing and keeping track of side pots and bridge the gap between playing a poker game at home, and playing a game at a casino. Through careful design this version of Texas Draw can successfully deal and keep track of pots. One of the main, easily fixable, problems is the battery life while dealing isn't conducive to the long play time involved with poker. So this version of Texas Draw, although the demo does show off the dealing feature, is to be a mobile pot, preventing reaching across a long poker table for chips, helping people not forgot, or mishear bet, and stop the user from going through the hassle of managing multiple side pots in big hands. Texas Draw's range of sensors and actuation coupled with careful programming and pot tracking algorithms allow Texas Draw to make a casual poker game much less of a hassle and allow

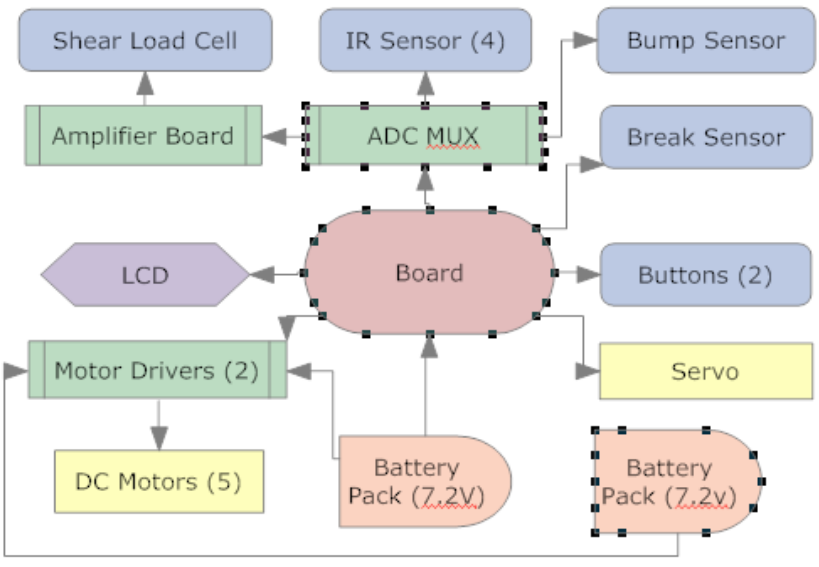
the user to concentrate on his poker face instead of calculating side pots. This version of Texas Draw also is not capable of differentiating between chip color and thus only one value of chip can be used.

Introduction

Texas Draw's purpose is to replace all the function of a Texas Hold'em style poker dealer. The only things that a dealer usually does that Texas Draw will not be able to do is determine which player is the winner and cut the cards, these actions will be prompted for. With electronics and motors combined with careful design and extensive programming Texas Draw could readily replace the Texas Hold'em dealer in both casual games and tournaments and will help casinos by cutting the costs of hiring dealers as well as even provoke people to favor their casinos for the amusement of being dealt poker by a robot.

I will be outlining the tentative behaviors, platform design, sensor layout as well as possible problems I might have to overcome while constructing Texas Draw throughout this report.

Integrated System



The robots systems are all arbitrated by the main board. There are 4 intermediary boards for a variety of purposes. The Shear load cell is rand through and amplifier board which both amplifies and filters the noise out of the weak noisy load cell signal. The IR Sensors, amplifier board, and bump sensors are ran through a ADC multiplex due to the lack of enough ADC ports on the board. And the motors are ran through 2 motor drivers. The other sensors, the break sensor and the 2 buttons are run directly to the board as well as a LCD screen. The board is powered by one 7.2V battery pack and the motors are powered by two 7.2V battery packs in series.

Mobile Platform

When designing the platform for Texas Draw I wanted to emphasize the size of the robot. In order to have a usable poker dealer it has to be able to fit and function on an average size table. In order to facilitate this size with a mildly complex mechanical robot the platform is designed in layers. The bottom layer for housing the motors and servos, the middle layer to hold the card shuffler and batteries and the top layer for the electronics (motor drivers will still be with the motors) and the force gauge (a hacked digital food scale). The front of the robot will have the LCD displayer the card slot for folding, the button thus putting all user interactions areas next to each other. On the left side of the robot is where the shuffler outputs and where the card flipper is to allow for fast dealing without turning. The platform also has the appropriate wiring holes and holes for mounting electronics and motors.

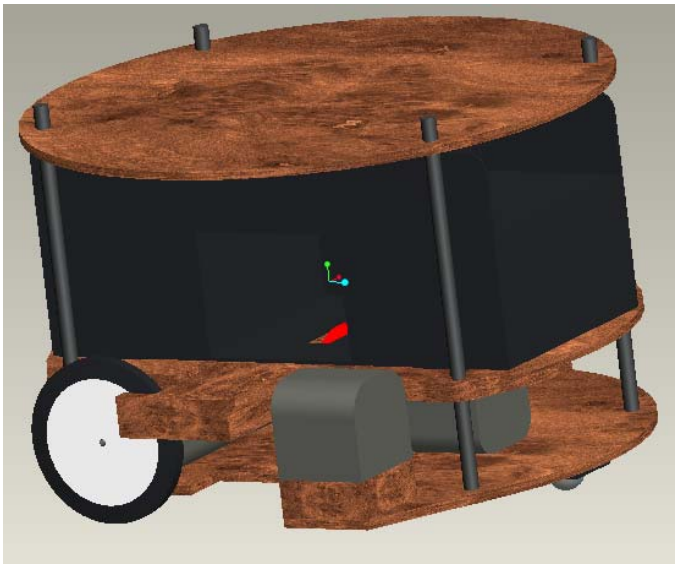


Figure 1 Mobile Platform Design

The platforms are held together with 6" carriage screws and nuts holding each platform at the appropriate level. The circular shape is to promote 2 wheels turning.

Actuation

The purposes of the actuation on Texas Draw has is to move, steer, shuffle, deal and flip cards. This is done with a series of actuators. Actuators have yet to be purchased as proper platform weight has not been calculated and proper torque is not known. 2 motors will be used to move the Texas Draw and will be capable of both forward and reverse motion in order to allow for turning. 1 motor will be used to deal cards; the motor will be attached to a rubber will to shoot cards from Texas Draw. A servo will be used to flip cards. The servo will be attached to a wooden card sized plate that on one side will be smooth and on the other there will be a stopper on the end. If a card is to be dealt face down the plate will have the smooth side face up. If the card is to be dealt face up the plate will have the stopper size face up, the card will be dealt into the stopper then the servo will flip the card. And lastly there are 2 motors already wired within a hacked card shuffler that shufflers cards. These as with all the other motors will be controlled with motor drivers. Driver circuits have yet to be made.

Sensors

The sensors in Texas Draw have to handle navigating the poker mat and keep track of the pot size and folding. Sensor data has not been collected so there are no charts or graphs describing the data. Also no sensors have been wired, thus no circuits are available yet.

Photo Interrupter CNZ1120: The photo interrupter has an IR emitter on one end and an IR detector on the other end and detects when the IR beam is broken. It is going to be used detect when cards are folded. The sensor will be placed in front of the fold card slot and will help the Texas Draw keep track of game.

Figure 2 Photo Interrupter

Large Optical Detector / Phototransistor SEN-08181 (X4): This sensor housing an IR emitter and an IR detector housed in its tip. It sends out IR beams then measures the Intensity of the reflected IR beams. They will be used for line detection since darker colors absorb more IR then lighter colors and the sensor can detect which it is pointing at. These sensors will be used for line following.

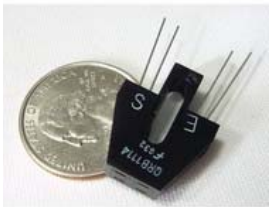


Figure 3 Large Optical Detector

High Precision "Strain-Gauge": The Strain-Gauge is being obtained from a "Stylish Digital Desktop u Glass Scale 3KG". This sensor is capable of measuring up to 3kg at a resolution of 1g. This will be used to measure the amount of poker chips (poker chips are a uniform weight) on Texas Draw.

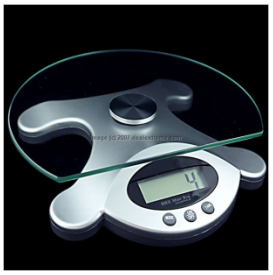


Figure 4 Digital Glass Scale

Bump Sensors(x3): The bump sensor will be attained from the lab. They are a simple switch that will be used as a button and possible for emergency obstacle detection. Two will be used as buttons.

Behaviors

The basic behaviors of Texas Draw are line following, shuffling and dealing. Line following follows the basic premise set out in "Reliable Line Tracking". It uses 4 phototransistors to track the line set up in a row. The middle 2 phototransistors are used for basic line following, if the line is no longer under one but is under the other the motor on the side with the line reduce speed until the line is under both lines again. If the one of the outer sensor picks a line Texas Draw performs a 90 degree turn in that direction (one motor in reverse the other going forward). If both outer sensors pick up a line then Texas

Draw reached an intersection and simply continues forward and iterates which player Texas Draw is at and performs actions accordingly.

For shuffling Texas Draw simply ejects the deck (runs dealing motor for a certain period of time) and prompts for user to cut cards. The cut cards are then placed into either side of the hacked card shuffler. Once the user presses the button the motor driver attached the hacked shuffler is activated for a certain period of time and the cards are then shuffled into the dealing chamber.

Dealing involves line following, the dealing motor, and the servo. For dealing cards to player, Texas Draw line follows. At each intersection the dealing motor (motor attached to a rubber wheel that goes through a hole in the bottom of the dealing chamber) is activated for an extremely short period of time and shoots a card that passes over the wood piece attached to the servo. For dealing the flop, turn and river cards some of the cards have to be dealt face up. Texas Draw line follows until it reaches its dealing position and then deals a face down card (as described previously) and then the appropriate number of face up cards. To deal face up cards first the servo that is attached to the wood piece is turning 180 degree so that the side with a stopper is face up. A card is then dealt and caught by the wooden piece and the servo turns another 180 degrees and drops the card face up. This is repeated until the necessary amount of face up cards are dealt.

Texas Draw will follow the following steps after it is switched on. First it will display a startup message on the LCD and wait for its button to be pressed before running its program. This prevents Texas Draw from jumping around immediately after startup. Then Texas Draw will initialize its sensors, essentially zeroing out the force gauge. It will then begin to seek out the out the black line of the poker mat. Once the line is found (it seeks by simply moving forward because the Texas Draw should be placed in the middle of the mat to start playing) it tracks the line and stops at each intersection. At each intersection Texas Draw makes a 90 degree turn so the LCD screen on its front faces a potential player and prompts the player (using the LCD screen) to hit the button if he wishes to play and then after a button is pressed or 10 seconds has passed the robot proceeds to the next intersection until it has traveled the whole mat. The first intersection without a player is set as the dealer position; this is where Texas Draw will deal the Flop, Turn, and River cards. The first intersection in which a player is Texas Draw will prompt the player to place his starting chips on top of Texas Draw (on its force gauge) in which he number of chips will be stored as the starting chips for each player. This ends the startup phase of Texas Draw's system.

Next Texas Draw starts the game. A game a Texas Hold’em poker is split up into 5 segments, pre-flop, flop, turn, river, and post-river. This cycle can be cut short at anytime if only one player is remaining at the end of the round and is then immediately restarted, if there is only one player remaining pre-flop the game is ended. During the pre-flop Texas Draw goes to the player designated the dealer (which is iterated after each hand) and ejects the entire deck of cards and prompts them to cut and reinsert the cards into Texas Draw then press the button. Then Texas Draw proceeds to the next player and prompts for small blind and once the small blind is place on Texas Draw it deal one card and goes to next player and prompts for big blind. Big blind must be twice as big as small blind and Texas

Draw won't move until the appropriate bet is placed. Texas Draw will then proceed to deal cards to all of the players so that each player has 2 cards.

Texas Draw then goes into betting phase. For pre-flop the blinds will count as bets but in the other rounds betting starts at 0 and begins with the player after the dealer. Texas Draw goes to each player and takes their bet. The player places their bet on top of Texas Draw and hit the button and Texas Draw will proceed to the next player until no additional bets are made for a full rotation. To fold a player will simply place their cards into a card slot and Texas Draw will no longer stop in front of them for the rest of the hand. Betting must follow the following guidelines or Texas Draw won't go to the next player and the proper error message is displayed.

- The bet is lower than the previous bet.
- If the bet is higher than the previous bet, it is higher by at least the value of the big blind (value was stored for the hand).
- If the player folded and a bet was made anyway.

After betting phase Texas Draw returns to its dealing position and deals the appropriate cards for the current round.

~Pre Flop: 1 face down card followed by 3 face up cards

~Turn/River: 1 face down card followed by 1 face up card

~Post River: 0 cards

After the cards are dealt Texas Draw proceeds to a betting round followed by more dealing until it is the Post-River round. After betting on the river Post-river begins. No more cards are dealt and the Texas Draw goes to the last player who bet or the next remaining player after the dealer if no bets were made in the previous round. Texas Draw then prompts if the player won take the chips else fold cards. Texas Draw proceeds to the next player as cards are folded. Once the chips are taken the message will be changed to just fold cards and Texas Draw will wait for the winner to fold his cards and the go to all remaining players. After that Texas Draw will proceed to go to the next dealer ask him to cut the cards shuffle and proceed to the next round. This continues until only one player is left. At this point Texas Draw declares the winner and the entire program is restarted.

Conclusion

One of the main problems ran into was that Texas Draw isn't really cut out for a quick demo as is essentially the requirement for the class. So for demo Texas Draw deals one hand of 5 card stud, which has one round of betting and awards the winner the chips. No chip tracking or side pot management for the demo. The limitations that Texas Draw is planned to have is not being able to detect the color of poker chips (thus only one chip value may be used) and that Texas Draw can't cut cards. Color detection, all though possible with a CMU camera is unrealistic. The camera detects blobs of colors from one

direction and would not be able to tell how many of chips of each color there are with a pile of chips. A way to get around with would be to make custom weight poker chips in which the weight of the poker chip would be directly proportional to its value, allowing the weight of the chips on poker resemble the specified multiple of the value of the chips in the pot. This task is unrealistic for the tools I have access to as the weights of the chips will have to be at exact values.

To have Texas Draw able to cut cards would require a chained motor or a series of servos to move the cards up from the dealing chamber to either side of the shuffler. This would cause the size and complexity of Texas Draw to increase greatly and thus go against its original purpose, be an efficient and realistic poker dealing robot; if Texas Draw is too big it is no longer a realistic poker dealer. These limitations aside I am optimistic that Texas Draw will alleviate most of the hassles of player poker without a dealer and that I will use him for years to come.

Documentation

-Spark fun Electronics, http://www.sparkfun.com/commerce/product_info.php?products_id=8181

Documentation of products bought with them and pictures.

-William Dubel, “Reliable Line Tracking”, January 5, 2004

Guide for design and implementation of line tracking.