Wheelin and Dealin

By
Soham Makani
Leo Chen

Design Document for ECE445
Senior Design
Fall 2021

TA: YiChi Zhang

23 September, 2021

1 Introduction

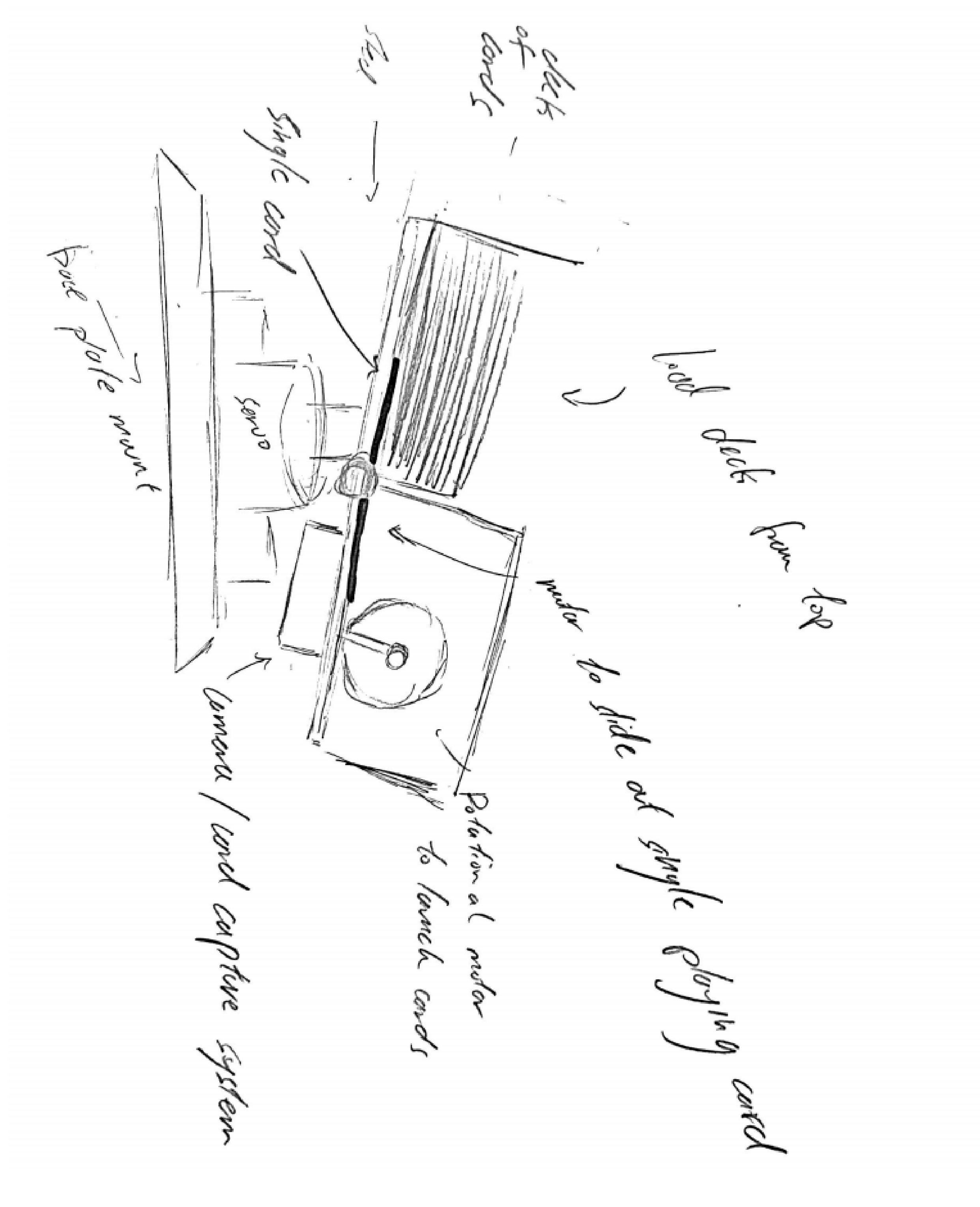
1.1 Problem Statement

Poker and other card games require shuffling and dealing after every hand. It takes seven riffle shuffles to completely shuffle and randomize a deck. The game needs to be paused and a player will need to take time to complete a task that is simple and can be automated. For games like poker this shuffling and dealing process can often make games feel tedious and a burden to play. For many recreational players there is no way to analyze their play in a long term GTO manner as data isn't kept for casual games. Currently RFID options for card tracking and hand results are expensive and impractical for a casual player. Many players want to keep track of their data over time as they want to improve their poker theory and experience but lack the data to do so.

1.2 Solution

We want to make a table/machine that will be able to deal accurately and efficiently while tracking card data. In order to ensure a seamless transition between hands it should be able to load two decks and automatically start dealing once the next hand is initiated. The robot will identify the number of players at the table, shuffle a deck of cards and deal cards face down to players present at the table. The robot should be able to deal to a circle of max 8 players and smoothly run a poker game with minimal human intervention (collecting cards and replacing the deck). Our solution should work for a variety of different tables supporting a variety of player distances and deal appropriately for 3-8 players. As the robot deals, it will send card data to be stored in a database as well as displayed using a simple mobile GUI allowing players to track data and data quickly and easily.

1.3 Physical Design



1.4 High-Level Requirements List

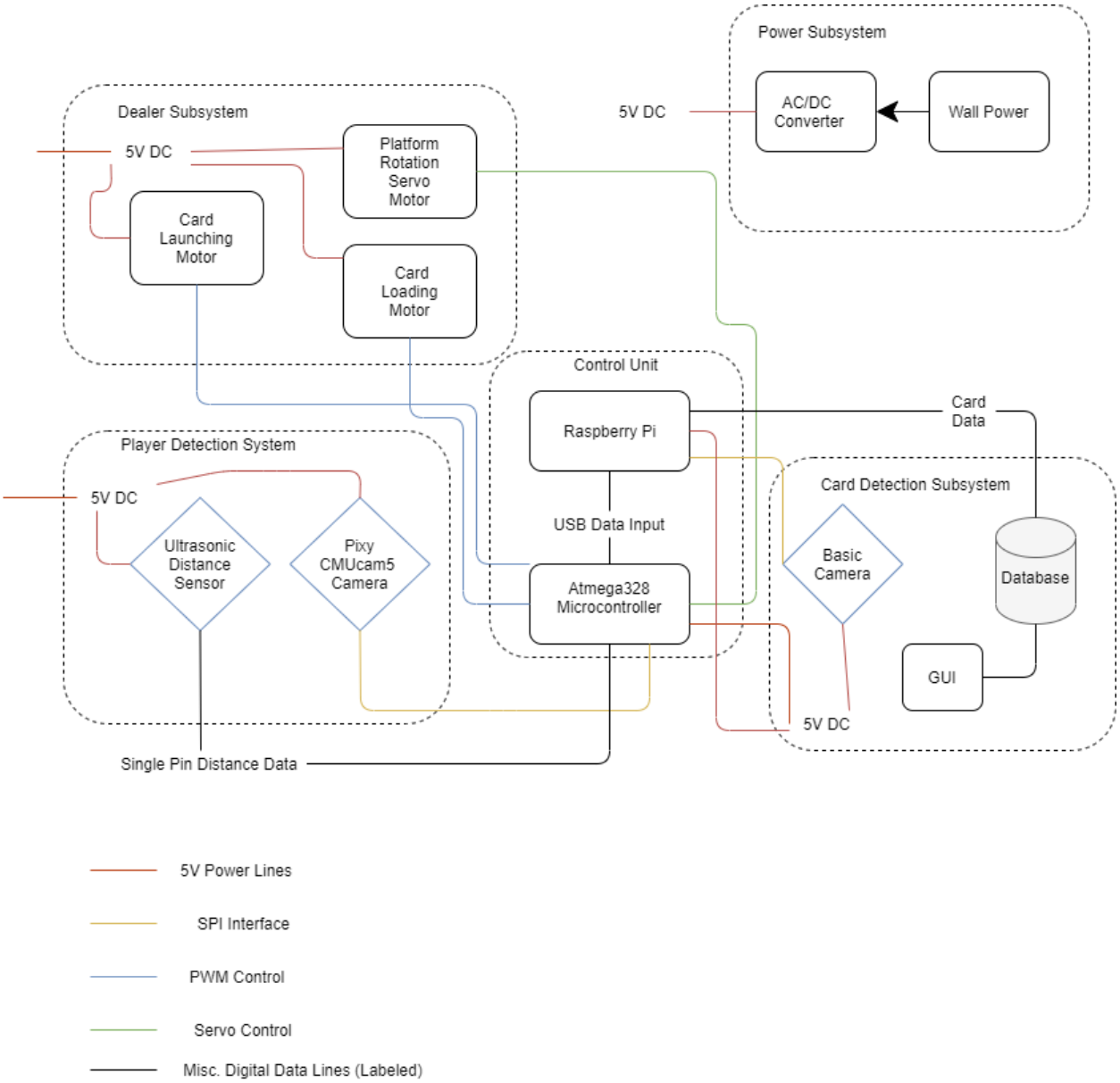
i. The dealer must improve efficiency of the game by facilitating dealing, shuffling, and data collection by a margin of 30%. The dealer should eliminate the need for a player or designated dealer to shuffle and deal as well as improve upon the efficiency and accuracy of a human dealer.

iii. The dealer should operate and identify players and distances accurately without human intervention. Additionally, it is important that the machine does not misidentify bystanders as players or incorrectly count the number of players in the game.

ii.The dealer should accurately track hand data and community cards dealt for players over a 100 hand period. The card data should be 95% accurate and stored in an external database.

2 Design

2.1 Block Diagram



The block diagram outlines 4 different portions that will work together in order to fulfill the high level requirements. The power subsystem consists of an AC/DC converter that can supply 5V DC power to all our components. The dealer subsystem is the section that removes a single

card off the deck and deals it to the player. The system consists of 3 motors. One which removes a single card off the deck and gives time for a camera to scan the card, another that actually launches the card to the player, and one that is used to rotate the entire platform. The control system consists of the Atmega328 microcontroller that controls the sensors, and a raspberry pi that processes the images of cards to identify them and sends the data to an external database. The player detection system uses an ultrasonic sensor and a Pixy CMUcam image sensor. This is an arduino compatible sensor that has built in block detection and communicates over SPI. The ultrasonic sensor is used to calculate the distance between the machine and a player after the PixyCam identifies them. Finally, the card detection system consists of another simple camera, and the database and GUI to keep track of the cards dealt to each player. The basic camera relays images to the Raspberry Pi, which then processes the data and sends it to an external database. This data is then displayed on the GUI.

2.2 Physical Design

2.3 Player Recognition Unit

This unit is responsible for identifying players and then identifying distance to players. The Pixie camera will identify a card/shape in front of a player present at the table. Upon detection of the player the pixie cam should send a signal to the microcontroller. The microcontroller should then take information from the ultrasonic sensor and send a signal to the motor system to begin dealing one card.

2.3.1 Ultrasonic Sensor

This sensor is responsible for sensing the distance to the player once they are detected. The sensor we chose is an ultrasonic sensor that can detect the distance between it and the first object in front of it. The sensor we chose is accurate up to 13 feet, which is more than enough for our needs.

2.3.2 Pixy Camera

2.4 Card Dealing Unit

This Unit involves three motors that are each controlled by the microcontroller. Upon detecting a player and stopping the dealer unit will initiate dealing a card by manipulating and activating the three motors. The 5V servo motor that spins the dealer will stop once the microcontroller receives signal from the player detection camera. Once the servo has come to a complete stop. The card slide motor should rotate 90 degrees to slide a single card 2 inches onto the dealing platform. After a preset period of time(in which the Card Recognition Unit activates) the card shooter motor will be started by the microcontroller at an RPM calculated using weight of card, distance of player, and surface friction of table. The card dealt should land face down within a 12 inch by 12 inch square in front of the player

2.4.1 Card Slider (motor)

This motor slides a single card away from the deck so it can be read by the card reading unit and dealt by the card shooting motor. This motor requires high precision and low RPM so we have selected the 108990003 seeed Stepper motor. Stepper motors turn in small increments; this specific one has 2048 steps per revolution allowing us to precisely tune where the card will slide to.

Requirements	Verification
1. The motor must be able to receive output from the microcontroller and stop in steps accurate to ± 0.17578 degrees(1 step). 2. motor slider system must be able to slide a single card 2 ± .1 inches forward and stop the card before it reaches the launcher	1. Connect the motor to 5v DC power 2. Connect motor control pins to Microcontroller 3. Program Microcontroller to send variable angle settings to motor 4. Verify motor reaches desired angle ± 0.17578 degrees

2.4.2 Card Shooter (motor)

This Motor will launch the card after it has been slid out and scanned by the card slide motor. It needs to launch the card with accuracy and distance as well as face down. It will receive a motor speed from the microcontroller and then activate to launch the card to a player.

Requirements	Verification

3. The motor must be able to receive output from the microcontroller and start and stop properly to launch a single card face down 4. The Motor should be able to rotate at 30 RPM, 60 RPM, and 90 RPM	5. Connect the motor to 5v DC power 6. Connect motor PWM pin to Microcontroller 7. Program Microcontroller to send variable RPMs to the motor 8. Verify motor spins at proper RPM

2.4.3 Dealer Rotation Servo

This motor carries the weight of the entire dealer and rotates the dealer accurately and quickly. The SER0035 from DFRobot has a dynamic torque of 15.1kg.cm which is well within our weight tolerance and it has a no load speed of 60°/0.16s which should be much faster than desired for our dealer. The Servo takes a PPM signal which gives the servo position. We will need to vary the voltage delivered to the servo in order to ensure the servo speed is not too fast nor too slow.

Requirements	Verification
5. The servo must be able to rotate the dealer platform (~5lbs) 180 degrees within two seconds. 6. The servo position must be accurate to ± 3 degrees from calculations	9. Connect the servo to DC power 10. Connect servo PPM pin to Microcontroller 11. Program Microcontroller to rotate servo 180 degrees 12. Verify servo position upon stop and time servo speed from microcontroller signal to full stop.

Requirements	Verification
7. The dealer must successfully deal cards to players 1,2,3 and 4 feet away face down into a 12 inch by 12 inch square with a success rate of over 90%	13. Set up the entire dealer system. 14. Adjust servo to player position based on angle. 15. Start the card slider motor to slide card 16. Start card dealer motor to deal card to player 17. Verify card is in 12 inch by 12 inch predetermined square in front of player 18. Repeat 100 trials to ensure accuracy, and consistency

2.5 Power

This Unit powers the entire dealer, all parts use 5V AC/DC

2.5.1 5V AC/DC Converter

2.6 Card Recognition Unit

This unit should identify when a card is present in front of the camera and capture an image to be sent to a server after the server processed and identifies which card has been slid into be dealt the data will be stored in a SQL database. A mobile application will have endpoints that allow it to fetch data from the database and identify the past 100 cards that have been dealt by the machine.

2.6.1 Arduino Camera/Arduino

2.6.2 Image Recognition Software

2.6.3 SQL database

2.7 Control Unit

The Raspberry pi will work in tandem with the microcontroller to control the motors and deal cards properly for each type of game. The control unit will feature selectors to select the type of game and number of players. Need more communication with TA to decide what is feasible after third partner MIA

2.7.1 Raspberry Pi

2.7.2 Microcontroller

2.8 Schematics

2.9 PCB Design

2.10 Tolerance Analysis

2.10.1 Card Shooter Physics

2.10.2 Image Recognition/Machine Learning Success Rate

3 Cost and Schedule

3.1 Cost

Part	Cost	Link
Ultrasonic Sensor - HC-SR04	~$4	https://tinyurl.com/5yhbynd7
Microcontroller - Atmega328p	~$3	https://tinyurl.com/59m2u9ru
Platform Servo Motor	~$18	https://tinyurl.com/hkkk5e5f
Card Launching Motor	~$3	https://tinyurl.com/7mjbbe4n
Card Removing Motor	~$14	https://tinyurl.com/p3e7ddbe
Player Detection Camera	~$60	https://tinyurl.com/y7pdxatm
Card Camera	~$24	https://tinyurl.com/x7w8css6

3.2 Schedule

4 Ethics and Safety