IOWA STATE UNIVERSITY

AEROSPACE ENGINEERING DEPARTMENT

Computational Techniques for Aerospace Design

AERE 361

Project Proposal

Team 10

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I ABSTRACT

Blackjack, a commonly known household game, is often used to teach players another strategy: counting cards. Studies show that counting cards is an exercise in memory, mental math, and probability and statistics, and counting cards increases the player's chance of winning. This project will entail the creation of a handheld Blackjack game. The game will consist of the display of an Adafruit CLUE board, the built-in board buttons, along with three additional buttons. Along with the basic features of Blackjack, the game will feature a card counter that can be displayed when the user requests. Through this game, the user can practice basic Blackjack strategy and counting cards, enabling players to beat casinos at their own game.

II INTRODUCTION

Counting cards in Blackjack is commonly frowned upon at casinos, to the point it can get a person banned. However, studies have shown that counting cards helps with mental math and memory, and is an application of statistics and probability [1]. While players may not plan on becoming a Blackjack expert or playing in casinos, counting cards is a strategy that can be used in a scenario as simple as family game night to improve a player's chances of winning [5].

Technologies such as cell phones and laptops are capable of having card counters, but it would be fairly obvious if these were being used while playing Blackjack. Therefore, it is beneficial for players who wish to count cards to learn how to do so without any external assistance. This project will provide an aid in the process of learning to count cards in the form of a handheld Blackjack game. Players can practice basic strategy while playing a computer. If desired, players can count cards and check their counts by using a built-in counter displayed upon request. With enough practice, players can learn how to mentally count cards, improving their odds of winning Blackjack.

III FEATURES

The first feature of the Blackjack game are buttons to hold, hit, and split. These are essential functions, as the game cannot be played without them. Having buttons for these features is easier and more accessible for the player than having pop-up menus during the game.

The second feature utilizes the built-in buttons on the Adafruit CLUE board. These buttons will be programmed to display the card counter and end the game. The card counter will be controlled by a button so it can be displayed whenever the user wishes. This allows the user to mentally practice counting cards and check their counts whenever they desire. An end game button allows the player to end the game at any time.

The final feature will utilize the lights on the Adafruit CLUE board. The lights will show the result of the round, with green being the player winning and red with the dealer winning. This provides an easy visual aid to determine who the winner of the game is.

IV PROBLEM STATEMENT

One problem among children and adults is they are not proficient in mental math. Mental math is doing arithmetic using only the brain. Mental math doesn't include a pencil and paper, a calculator, or counting fingers. This skill seems to be a dying art, as more children and adults require a calculator to do even the most simple calculations, like addition and subtraction. A way to practice this skill while also having fun could be the key to incentivizing all ages to practice this skill. One effect of practicing mental math includes bettering emotional health, which can help with depression and anxiety [2].

When mental math is a practiced skill, there is greater satisfaction when solving simple math calculations, and time is saved from not having to pull a calculator out. Moreover, sharpening mental capacity is a goal for many people. One way to sharpen mental capacity is by holding a value in memory and applying basic math operations. Repeating this process not only enhances mental math, but is a great way to "delay memory decline and fight dementia, Alzheimer's, and other senility-related problems" [3]. As can be seen, mental math can have enormously positive effects on the health of your brain.

In addition, "the most common cause of mental decline is boredom, routine, and lack of challenging activities to do" [3]. To combat boredom, we want to devise a way to integrate practicing mental math with a stimulating game. A fun game will entice a player to play while disguising that the player is practicing their mental math skills.

Another area that can be addressed is creating a game requiring only one player. There is simplicity in playing a game against yourself. That's why games such as Solitaire have endured for decades and are still popular to this day. Tweaking this idea a bit, we can create a game that plays against the computer, so there is no need for another player. Overall, we want to find a solution to enhance people's mental math capacity while allowing them to have fun while doing it. Studies show that practicing a skill using a game is more effective because "fun motivates students and helps them pay attention and stay focused on the subject"[4]. Taking all of this into consideration, we intend to create a Blackjack game with a card counter that can be displayed by user request.

V PROBLEM SOLUTION

For the gameplay, 1 deck of cards will be stored in the system in arrays with each card being able to be pulled up to 4 times meaning the game will be played with 4 decks. A random number generator will determine which of the cards are pulled and inserted into the game. The code will check against the array of cards ensuring the chosen card has not been played 4 times up to this point. Once the card is cleared to be chosen, the count of times the card has been played in the array will increase by 1. Once the computer has dealt two cards to each player the player will be shown the total point value of their cards and the opponents. At this point the player will hit the button corresponding with their strategic choice to take another card (hit) or to keep the cards they have (stand). Once the player has chosen to stand, the dealer's second card will be revealed. Choosing the cards to be dealt will use

the same method as the initial deal for each card and the point total will be summed each time. The choice of cards will most likely be dealt with using a `do` loop so that the process will continue until either bust or stand with `if` statements inside for each player choice. If the player's cards total over 21 the loop would immediately exit with a message telling the player they busted illuminating the correct light. Once the player stands the computer will make the same decisions, abiding by a set of rules similar to those a casino dealer would follow. The outcome of the game would then be shown by the comparison of the computers point tally versus the players point tally. Should the player be dealt an ace and a card with a point value of 10 the game will tell the player they have blackjack and the hand will be over with protocol for winning followed.

The true purpose of this game is to allow players to test their skills at counting cards. When the trigger button is hit the game will display the current card count. The count will be determined using a simple system. Inside the array will also be the count value of the card. The method we chose to use divides the deck into three sections, low cards with a point value of 6 or less will be assigned a +1 value, mid range cars with point values of 7-9 will be assigned a 0 value, and cards with a point value of 10, also including aces, will be assigned a -1 value. This is shown in Table 1.

Card	**Point Value**	**Count Value**
2	2	+1
3	3	+1
4	4	+1
5	5	+1
6	6	+1
7	7	0
8	8	0
9	9	0
10	10	+1
Jack	10	+1
Queen	10	+1
King	10	+1
Ace	1 or 11	+1

Table 1: Card Point and Count Values

The computer count will be updated when each card is chosen through the process described previously. This count has no effect on the player or the way the game progresses–as far as the card choosing process is concerned. The count would only be reset once the number of cards that could be dealt reaches a predetermined minimum, or the player manually resets it reshuffling the decks.

We chose to allow each card to be chosen 4 times–essentially playing with 4 decks–because 4 decks makes it harder for players to count individual cards and increases the complexity of the probability calculation and encourages the use of our methods. It is also closer to the procedures at real casinos where they use multiple decks. The player will be playing against

a computer dealer where we will program in casino rules such as holding on 17 and hitting on 16.

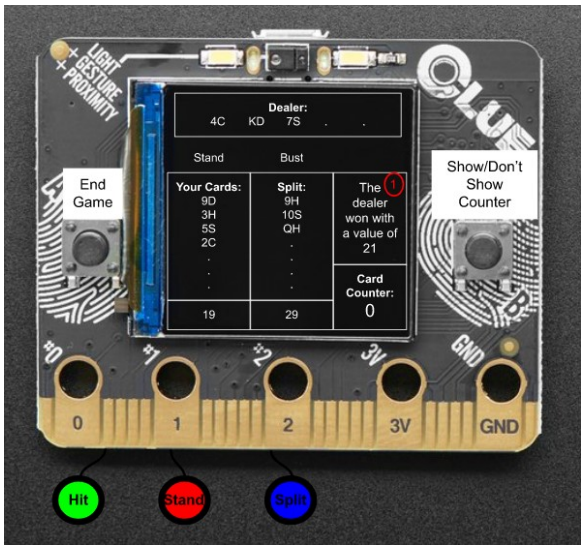

Figure 1: Concept mockup of the Adafruit CLUE Board screen displaying our Blackjack game.

Figure 1 above shows a concept of the clue board's display while the program is running. This is an example of what the display would show at the end of a game. The box marked with the red one is where information will be relayed to the user. This information could include their decision to "Hit", "Stand", or "Split". This area could also display any user error. For example, if the split button is used incorrectly, there could be an error message displayed. Since the figure above shows what would be displayed at the end of the game, an example of the display at the beginning of the game can be seen below in Figure 2

To effectively produce the handheld blackjack game we will need hardware provided to us. The list of hardware we will require in order to accomplish our task is listed below in Table 2. The arcade buttons are required for the user inputs "hit", "stand", and "split" in order to interact with the game while it is running.

Part	**Quantity**	**Additional Description**
Arcade Button	4	1 Red, 1 Green, 2 Blue
Adafruit CLUE Board	1	
Battery	1	For Clue Board
Battery Connector	1	

Table 2: Parts Required for Blackjack Handheld Game

VI CONCLUSION

The goal of this project is to create a functioning game of blackjack where the player competes against the computer. This game will use multiple decks of cards in the form of a list in

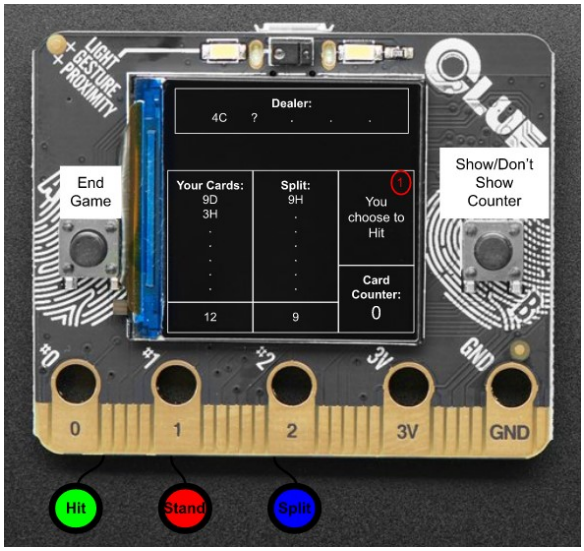

Figure 2: Concept mockup of the Adafruit CLUE Board screen displaying our Blackjack game.

the system. User input will determine if they hold or are given a new random card. This will progress until either the user or the dealer busts at which that point a winner will be declared.

This game will also utilize basic card counting strategies to help the player compete against the dealer. The purpose of this is to help teach the user how basic card counting works. Since card counting is just statistical analysis of one or many decks of cards, this can also be applied to other card games. Teaching the user how to count cards can help them in the future during other card-based games.

References

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