The Blackjack robot player

Design and Implementation Using Arduino and CAD

Integrated Group Robotics Project - B39VT

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Abstract

The blackjack robot player was designed to entertain the elderly community in care homes. This project had to consider various factors when picking a game, where ultimately blackjack became the best option. However, improvisations were made when showing the output of the work, due to the remoteness of the participants and the lack of physical interaction. Nevertheless, the robot was successfully able to play a game of blackjack against a human, based on a navigation system [6], various servo motors, sensors, and microcontrollers that were implemented.

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Introduction

Robotics is the combination of electrical engineering, mechanical engineering, and computer science. These disciplines are used to create machines called 'robots' with the main purpose of replicating or substituting for human actions using sensory inputs which are fed into microcontrollers to determine the resultant action. In the last decade, robotics has become more prevalent in modern-day life, whether it is self-driving cars or the Amazon Alexa, making it a well sought-after skill that employers look for.

For this group assignment, Solo Games contracted the team to design and implement a robot that can play a game of anyone's choice against elderly people in a care home. Once started, the robot should run without any other inputs from the operator.

Due to the course being conducted online, the robot implementation's demonstration had to be simulated, rather than physically created.

The chosen game was blackjack due to the game's simplicity, how well known it is, and the endless possibilities of expansion to other card games in the future. The game would initially be designed around a player versus robot setting, with further players to be added in near future. The design would include a distance sensor to detect the player, three servos motors which would be used to emulate a dealer to shuffle the deck and deal the cards, and an RFID scanner that would provide feedback to the microcontroller the cards that have been dealt to the player.

This report includes explicit detail on the game selection process, the rules of blackjack, the mechanical design of each element in the system, the software design that interacts with the microcontroller to control the system, and an evaluation of the overall project as a team.

Game selection process

Based on the given specifications and the people this interactive system is geared towards, several ideas were brainstormed. As the game is going to be played by elderly people in care homes, the game needed to be simple, well-known, and effortless because everyone should be able to play it. Therefore, after a lot of brainstorming, the five very viable candidates were:

- Countdown
- Connect 4
- Battleship
- Card Game
- Basketball

However, the two other factors considered when picking the final one were as following. The first question, is it easy to implement? As there were approximately two months to finalize the project, so the amount of time expected for each game to fully implement was considered. The second question, could it be further improved in the future? The versatility of the robot is important because robots are currently expensive to manufacture. Through having a robot that can easily be used for multiple tasks/games in the future is another aspect into consideration.

Thus, the decision made was to create a robot that would play a card game. Once the interface has been created to play a card game, more card games can be easily implemented making minor changes in the hardware or none.

The chosen one had a level of complexity and versatility, Blackjack. This game does not require complex mathematics or strategy, and almost everyone has played it at least once. For this reason, the robot is prepared to act as a casino dealer for anyone wanting to play Blackjack.

Rules of Blackjack

A normal blackjack table consists of a dealer who will shuffle the cards and will deal out two cards to each player and themself. The robot uses a mechanical shuffling function using servo motors to shuffle the cards and it will spit cards out to the players using a servo motor onto some sensors around the table.

Figure 1 Rendered prototypes of the robot.

In blackjack, the aim is to get as close to 21, without going over, which is called going bust. This is done using playing cards where each card represents the number on them, with face cards being 10 and an ace being either 11 or 1. This begins with two cards, and having the option to either twist, get another card at random, or stick, keep the already dealt cards, the maximum number of cards possible 5. The robot has twist or stick buttons that either give another card or keeps the cards at that number and reads them in to calculate the winner it also has a limit of 5 cards per player. When everyone has either stuck or gone bust the robot reads in the cards using RFID chips and declares a winner.

The blackjack table will be placed on top of a turtle bot as this will make it mobile this will allow the robot to move to the elderly people in the home. The game is designed to be very simple to play and do most of the mathematics in the Arduino so the elderly people can focus on having fun. Figure 2 shows the robot on top of the Turtlebot.

Figure 2 The robot on top of the Turtlebot.

For more information about how to play Blackjack watch the video in reference [1].

Gantt chart

At the outset of the project, the team put together an early draft of the GANTT chart. At the time, a lot of deadlines were piling up, both from the FPGA assignment and other courses were in consideration. Therefore, the work does not properly start until March. At this early stage, there were also expectations for certain elements of the project to take much more work than they ended up taking.

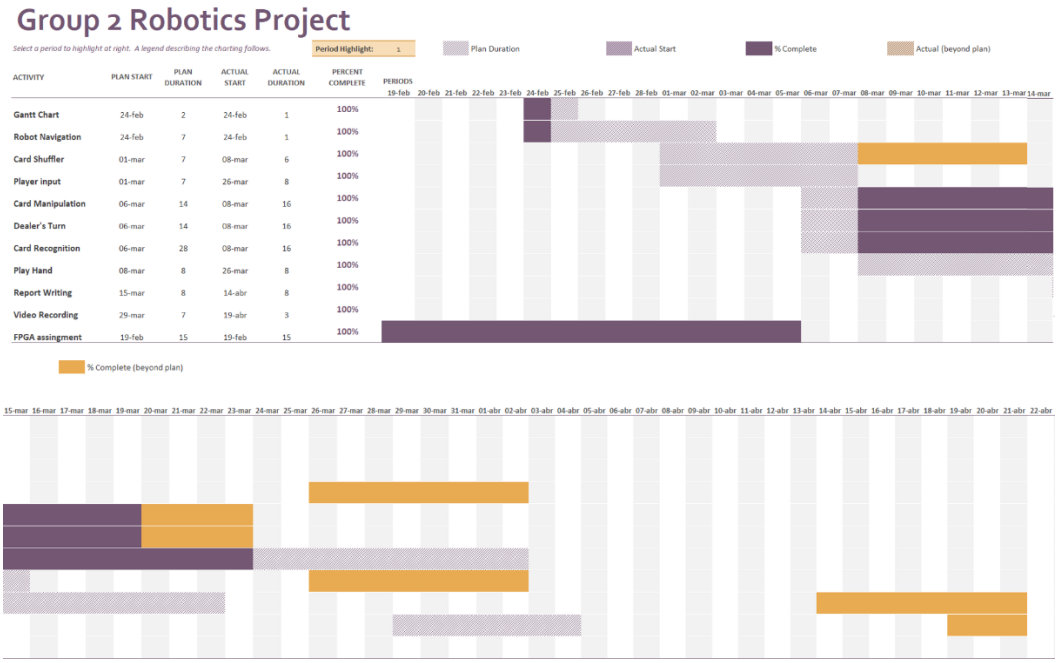


Figure 3 Gantt Chart

There is a zoom-in version of the Gant chart in the Appendix.

Starting the Robot

This flowchart demonstrates the general sequence for the robot playing blackjack. The algorithm is initiated once the shuffle button is pressed to successfully shuffle the cards into a mixed deck. Then the robot can deal out two cards to each player playing blackjack, the dealer receives two cards first and the player receives two cards afterward. The flowchart's subsequent commands are predefined processes that involve: the player's turn, the robot's turn, and comparing results.

Figure 4 Robot's activation flowchart.

Player's Turn

A flowchart was created to plan the C++ code for the player's turn, this was intended to make the procedure of robot dealing cards to the player more understandable. This began with the robot distributing two cards player and is followed with the option to either twist; gain another card, or stick; keep the cards already dealt for the robot to play. The use of a physical deck of cards and the RFID reader meant that there was no need to simulate any randomization. Each button pressed affects whether the player's state is stored as Safe, Ideal, or Bust because this is dependent on the total card number received from the robot.

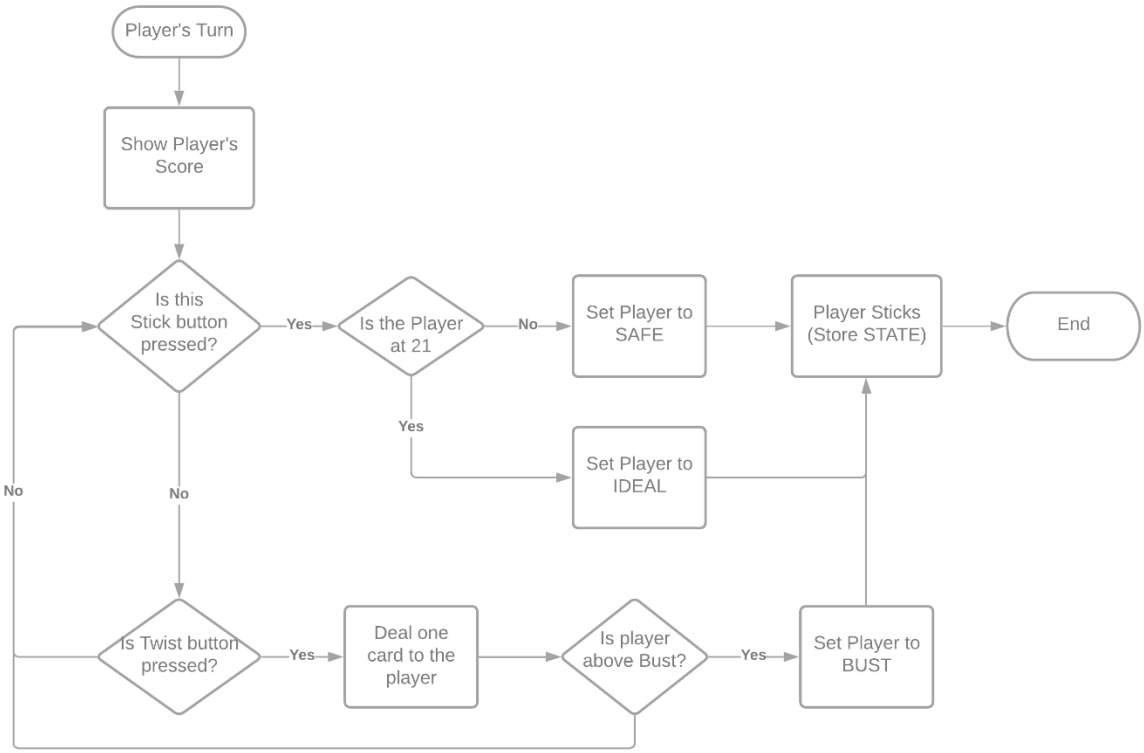


Figure 5 Player's turn flowchart.

Whenever the player sticks at the first interaction the player's state is stored as safe with a total card score of under 21 or a state stored as ideal for a total card score of 21 due to a pontoon, this occurs when the player has exactly been dealt 21. However, the player may press the twist button to generate another card that adds to the total card score. This allows the total card score to either be close to or reach 21 to increase the player's chances of winning against the dealer. However, there is a chance for the total card score to exceed 21 and this causes the player's state to be stored as bust. Once the state is stored as "bust" the player automatically sticks for the turn given to the dealer.

Robot's Turn

The dealer does not need to apply any game AI as dealers in Blackjack are restricted to a specific set of rules. The flowchart for the robot's turns involves the robot checking whether the total card score is above 17. Normally dealers stick when their total card score is 17 or above, therefore the algorithm

causes the dealer to always stick to avoid achieving a total card score above 21 that would result in a "bust" state. Furthermore, the dealer may have a two-card pontoon that means the total card score is 21 and automatically sticks to store the state as Ideal. However, the dealer with a total card score is below 16, then the dealer twists to receive another card to add the score to get a total closer the 21. Even though this increases the chances of winning against the player, there is a chance for the dealer to go bust. This occurs if the random card received for the dealer accumulates a total score higher than 21 that stores the dealer's state as "bust" and immediately sticks.

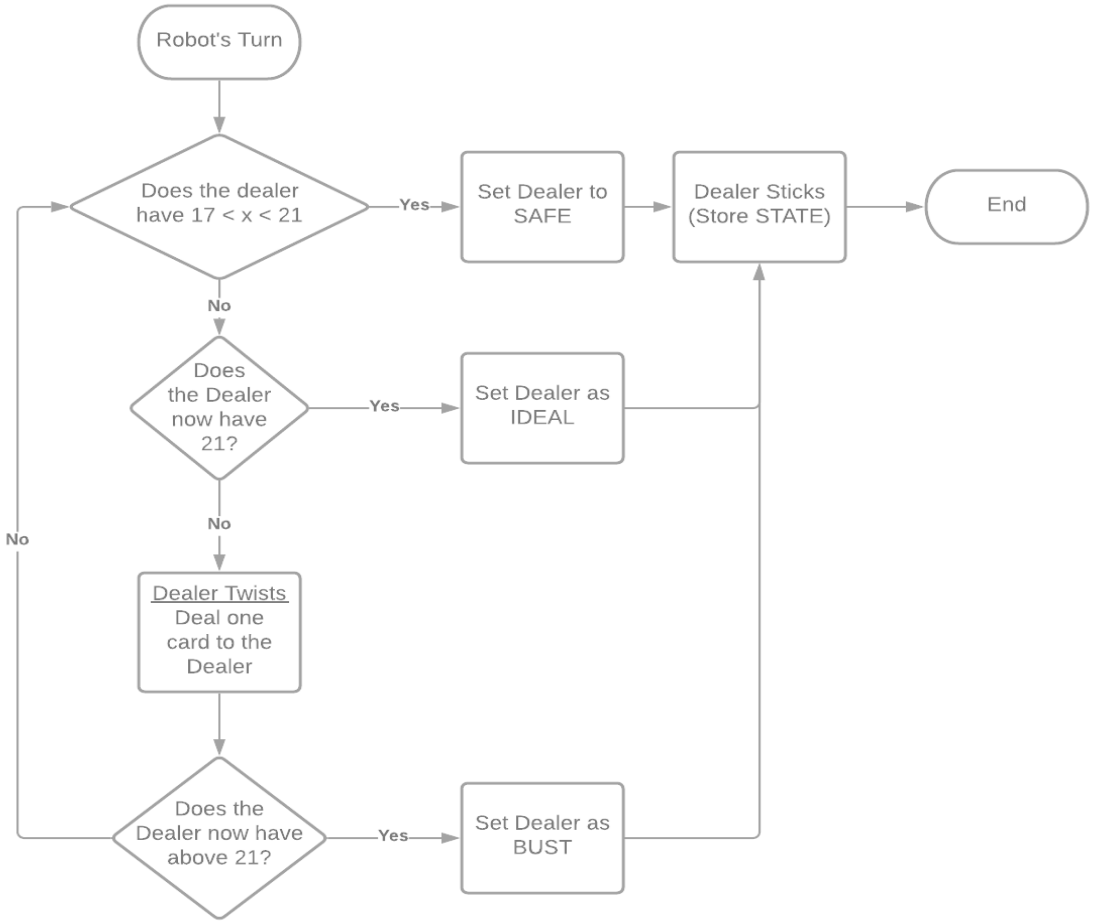


Figure 6 Robot's turn flowchart.

At human-run blackjack tables, one of the dealer's cards is kept hidden during the player's turn(s) so that they can never be certain whether they have already won or lost. Normally, this card is turned face down but to avoid needing to implement complex mechanisms to flip cards at will, the system has one of the dealer's cards covered by a screen until the dealer's turn begins.

The only remaining challenge was dealing with the ace cards. An ace in blackjack can be played as either a 1 or an 11. To streamline the process, the system treats all aces as 11 until it reaches its arbitrary maximum value or went bust, over 21. Then, it checks whether it can remain in play by treating its aces as 1 and continues if possible.

Comparing results

Planning

The flowchart, shown in Figure 7, was made to plan how to compare the results and decide the winner of the game. This helped in coding the game.

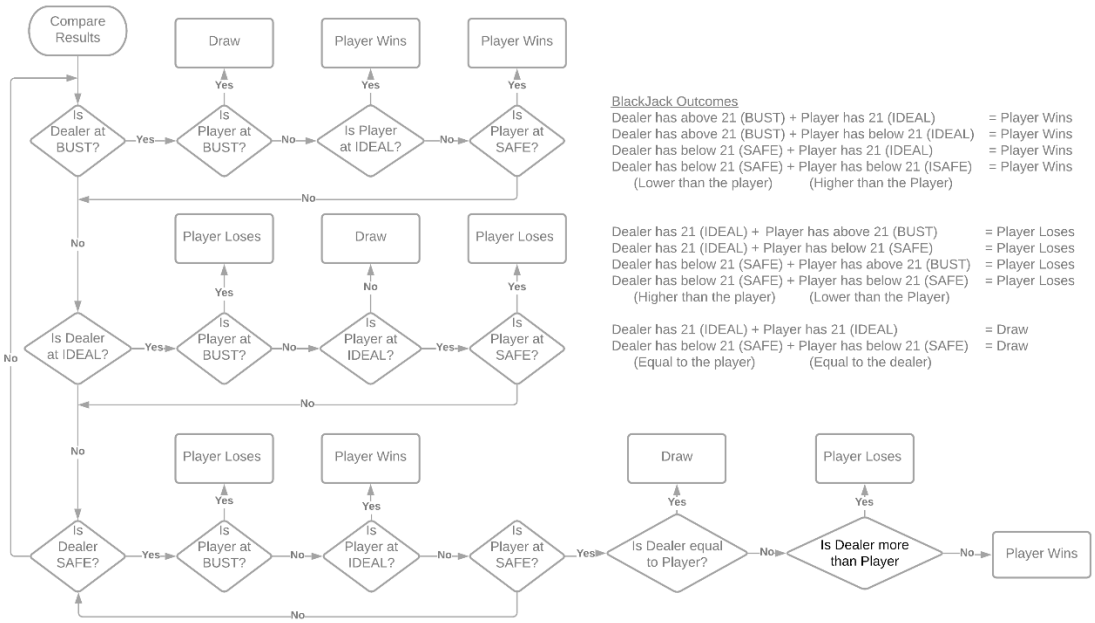


Figure 7 Possible outcomes flowchart.

This flowchart illustrates all the possible outcomes for the end of the game results to determine whether the player wins, loses, or draws against the dealer. Through comparing the results of the potential states between the player and dealer. For example, the player wins when they achieve an ideal state, and the dealer stores a bust state. However, the game is lost when the player stores a bust state, but the dealer stores either an ideal or safe state. There is also a possibility for the game in a draw when the player and dealer both go bust or have the same score as each other.

Card detection

To allow the game to read the cards and compare the results the system uses RFID, Radio Frequency Identification, chips as these are already used in a lot of televised poker tournaments and therefore have been proven to be able to identify cards in practice. Exploded view of the card and reader on the table can be seen in Figure 8.

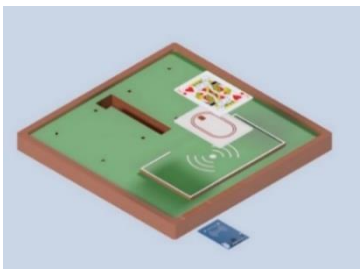


Figure 8 Card detection example with RFID chips.

RFID chips use an integrated circuit and antenna to transmit information to an RFID reader. High-frequency RFID chips have a reading distance of 100mm and can pass through almost all materials apart from metal. This allows them to be embedded into the cards. RFID chips are flexible allowing the cards to bend like normal and reducing the chances of damage.

RFID chips are relatively cheap with each chip costing 28p so a full pack of cards would cost £14.56 to fit with RFID chips.

Unfortunately, due to COVID-19, this had to be simulated making the game and the simulation software without including RFID chips or readers, so as an alternative to this, the system uses buttons like a calculator to input the card numbers manually (Figure 9).

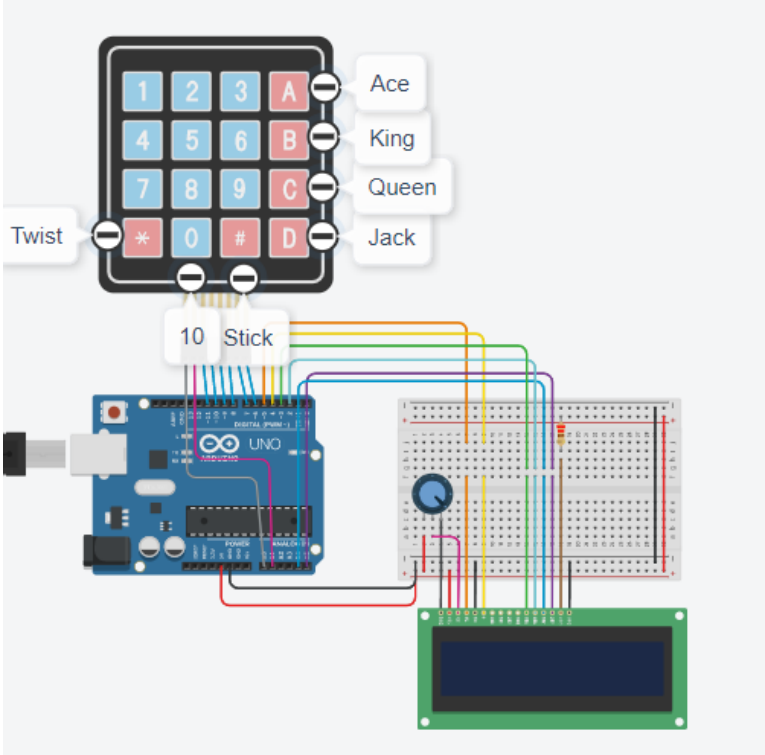


Figure 9 Alternative Tinkercad simulation for card detection. [2]

The code

This code compares the inputs given by the simulation in Figure 10, this was similar to the flowchart that it was based off.

```
if(robotbust == true && playerbust == true){ //if they are both bust they draw
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("draw");
  delay(1500);
  exit(0); //then the game ends
}
else if(robotbust == true && playerbust == false){//if only the robot is bust the player wins
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Player won with");
  lcd.setCursor(0,1);
  lcd.print(playertotal);
  delay(1500);
  exit(0); //then the game ends
}
```

```
else if(robotbust == false && playerbust == true){//if only the player is bust the robot wins
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Robot won with");
  lcd.setCursor(0,1);
  lcd.print(robottotal);
  delay(1500);
  exit(0); //then the game ends
}
else if(robottotal < playertotal){//if the players total is higher that the robots and neither is bust the player wins
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Player won with");
  lcd.setCursor(0,1);
  lcd.print(playertotal);
  delay(1500);
  exit(0); //then the game ends
}

else if(robottotal > playertotal){// if the robots total is higher than the player and they arnt bust then the robot wins
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Robot won with");
  lcd.setCursor(0,1);
  lcd.print(robottotal);
  delay(1500);
  exit(0); //then the game ends
}
else{ // if they have the same amount then they draw
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("draw at");
  lcd.setCursor(0,1);
  lcd.print(robottotal);
  delay(1500);
  exit(0); //then the game ends
}
```

Figure 10 Arduino code for card detection and result comparison. [2]

This code checks who the winner is, declares it and prints the score the winner had unless they both went bust. This is displayed on the LCD (Liquid Crystal Display) as shown in Figure 11.

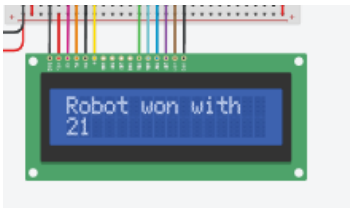


Figure 11 LCD used as output for game's result. [2]

Shuffle function

Mechanical design

The early design of this system was focused more on a virtual deck and card shuffling function with the user interacting through a screen and buttons instead of using a physical deck of cards. This however was changed to using a physical deck of cards as it gives the player a realistic experience when playing the game.

The final mechanical design of the shuffle function makes use of two different servo motors which rotate in opposite directions from one another. The servo motor rotates the arm which pushes the cards forward and are sent into the middle of the machine, ready to be dealt. The motors are controlled by the shuffle button on the front of the box and will continually spin until released. This

shuffles the cards in a random order to ensure the game is played fairly. To start the shuffling process the player will first have to place each half of the deck into the shuffling compartments each in which a servo motor will reside, then once the shuffle button is pressed the deck will be shuffled and the game can be played.

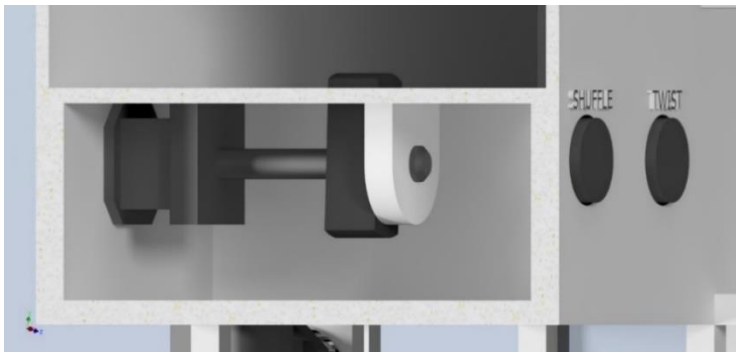


Figure 12 Mechanical design of Shuffle Function.

Microcontroller Interaction

The system is controlled by a button that will power the servo motors when pressed and continue to power them until the button is released. When the button is pressed the microcontroller will supply voltage to the motors which will each turn in opposite directions resulting in the shuffled cards.

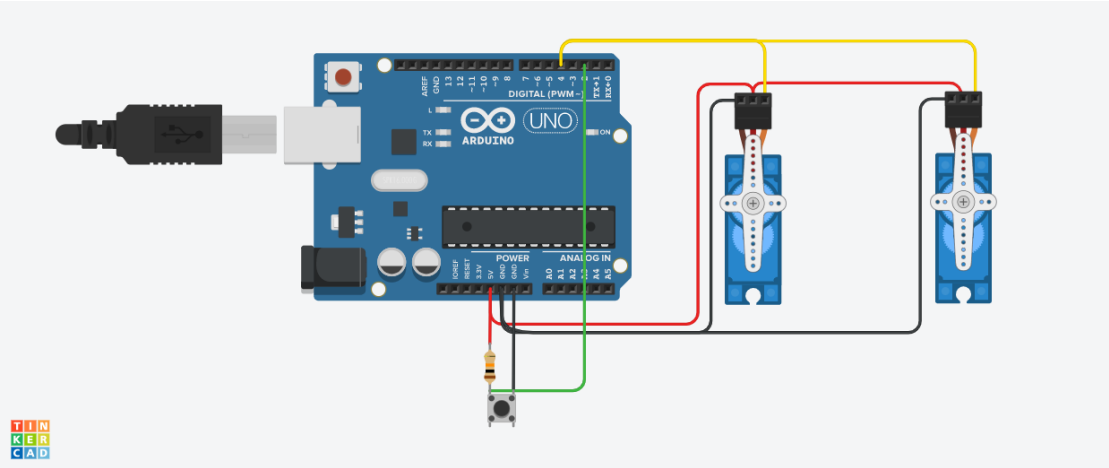


Figure 13 Design of shuffle system using Arduino microcontroller. [3]

The two servo motors are powered by the button that is connected to the 5V pin on the Arduino. This determines whether the button has been pressed because the voltage will successfully connect to pin 2 as an input. Therefore, the Arduino activates pin 4 as an output to deliver voltage to both signals of the servo motors. Since both motors have their ground and voltage supply rightfully connect, the activated signal allows the servo motors to rotate in sync. Based on the compiled code, the servo motors are synchronized to allow the cards to fall into the shuffled deck from each side. Figure 14 displays the implementation of the shuffle function with comments to show how this output was achieved through the Arduino.

```
#include<Servo.h>

Servo myservo;
int pos = 0;

void setup()
{
  pinMode(2,INPUT);          //Assigns button to pin 2
  myservo.attach(4);         //Assigns servo motors to pin 4
}

void loop()
{
  //While the button is pressed, the motors are activated
  if(digitalRead(2)==LOW){
    //Rotate both motors from 0 to 180 degrees
    for (pos = 0; pos <= 180; pos += 1){
        myservo.write(pos);
        //This delay determines the speed of rotation
        delay(2);
    }
    //Rotate both motors from 180 to 0 degrees
    for (pos = 180; pos >= 0; pos -= 1){
        myservo.write(pos);
        //This delay determines the speed of rotation
        delay(2);
    }
  }
```

Figure 14 Arduino code implementation of Shuffle Function. [3]

Twist function

Mechanical design

The mechanical design of the twist function requires a single servo motor that drives the synchronous belt and dispenses a card from the shuffled deck to the player. The cyan blue extrusion on the belt pushes the card from the bottom of the deck down the ramp at the front of the game onto a platform from which the player can take the card (see Figure 15). The servo motor will drive the belt until the extrusion returns to its initial position.

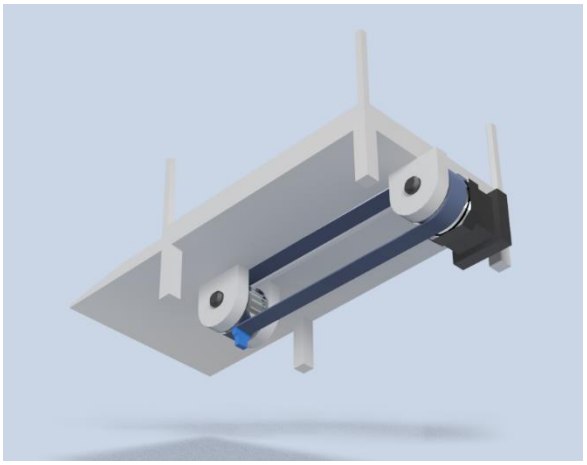


Figure 15 Mechanical Design of Twist Function.

Microcontroller Interaction

Pushing the twist button activates the microcontroller to send a pulse to the servo motor, which rotates at constant speed until the belt returns to its initial position, ready to dispense another card. Designing this on a breadboard, the layout requires a button to be pressed which connects the voltage

signal to pin 2. This activates pin 3 that is connected to the signal port and allows the servo motor to rotate once fed with an electric signal. As shown in Figure 16, it is evident that the microcontroller circuit successfully emulates the twist function as the servo motor rotates as the twist button is pressed, which in turn, will dispense a card to the player.

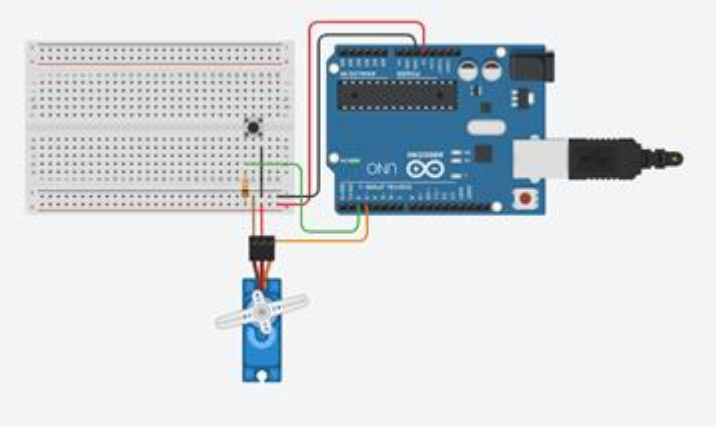


Figure 16 Design of twist function on a breadboard using Arduino microcontroller. [4]

For the twist function to operate appropriately the twist module had to be implemented through C++ code. Once compiled, this would allow the input devices to respond correctly to the microcontroller to the output devices on the breadboard. These blocks of code are followed by documented comments to show the reason behind including these commands.

```
1  //This library was required to enable the servo
2  #include<Servo.h>
3
4  Servo Myservo;
5  int pos = 0;
6  void setup()
7  {
8    //This activates the pin A2 as in input
9    pinMode(2,INPUT);
10   //The signal that causes the servo to rotate is at pin A3
11   Myservo.attach(3);
12 }
13
14 void loop()
15 {
16   //When the signal for the A2 port is not activated
17   if(digitalRead(2)==LOW){
18     //Then the servo motor remains still
19     Myservo.write(360);
20     delay (1000);
21   }
22   else
23    //But if the signal is activated from the button
24    //Then the servo motor actiavtes
25  Myservo.write(0);
26 }
```

Figure 17 Arduino code implementation of Twist Function. [4]

Stick function

Microcontroller Interaction

The stick function involves pressing the stick button that causes the robot to turn around from facing the player to the dealer. This required two motors that rotate at the same speed in both opposite

directions to perfectly turn. DC Motors were used rather than servo motors because they emulate the two wheels of the robot that allows movement. Therefore, the breadboard configuration has a push button that enables the voltage to operate movement within the for a specific amount of time, based on the microcontroller.

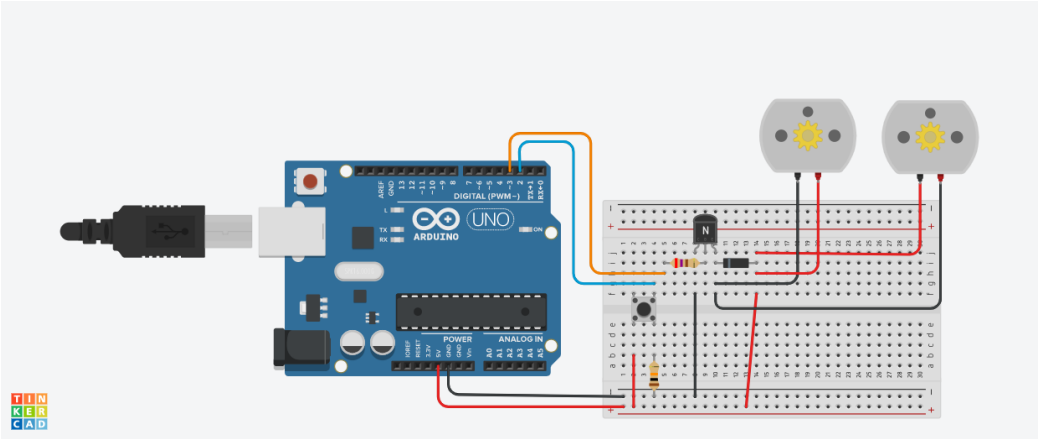


Figure 18 Arduino code implementation of Stick Function. [5]

The button acts as the input signal that allows the voltage from the 5V rail to connect and activate the input from pin 2. Through the Arduino code module, the activation of pin 2 would cause pin 3 to output a voltage for a calculated amount of time. Also, the circuit requires an N channel MOSFET for the motor to rotate because the NPN transistor allows current to travel from the base supplied by the Arduino pin 3 output to the emitter that causes the DC motor to simultaneously rotate. Furthermore, the emitter rail connects to the motor with a diode that forces the current to go through the motor and rotate in a specific direction.

The Arduino code module is implemented to make the stick button respond realistically to the user. Once the button is pressed, the robot waits for a brief period until the DC motors begins rotating to signify turning and prolongs the movement to continue the motion. Figure 19 explains the coded Arduino module with the detailed comments that are compiled into the microcontroller.

```
int buttonPin = 2;              //Assigns buttonPin to pin 2
int motorPin = 3;               //Assigns motorPin to pin 3

void setup()
{
  pinMode(buttonPin,INPUT);     //Button Input
  pinMode(motorPin,OUTPUT);     //Motor Output
}
//A while loop is required for the sequence to occur as the button is pressed
void loop()
{
  //Once the pin 2 input is activated from the button
  while(digitalRead(buttonPin)== LOW);
  //The short wait occurs after the button is pressed
  delay(300);
  //Now the DC motors be turned on rotate and emulate the wheels of the turning robot
  digitalWrite(motorPin,HIGH);
  //This longer delay allows the DC motors to continue rotating and keep turning position
  delay(2000);
  //Now the robot is at the intended position, facing the dealer, the DC motors can stop
  digitalWrite(motorPin,LOW);
}
```

Figure 19 Arduino code implementation of Stick Function. [5]

Results evaluation

The aim of making this game was to give some entertainment to old people in a care home. This has been done well as blackjack is a popular and fun game and enjoyed by most people. Having the robot/game manage the complex parts of the game means anyone in the home can enjoy themselves no matter their abilities. As the game meets all the specifications set and is enjoyable and fun, Solo Games would consider using this game.

Due to the restrictions of COVID-19, the robot and the game could not be created physically, but the team adapted and created detailed simulations and renderings to demonstrate the robot's functions.

Conclusion

The team set out to achieve a fully automated game that could be played with the elderly community in a retirement home. This meant the game had to be simple and fun as it was catered towards the older generation. The intended goal was to produce a robot to host games of Blackjack, a simple and fun game. Overall, the project was successful as the team was able to replicate a game of Blackjack to a high standard. This includes all the functionalities of a dealer using multiple sensory inputs and servo motors that provided the mechanical elements, allowing for a player versus robot setting, which was the intention from the beginning.

This project was an exciting learning experience for the group and gave a greater insight into the world of robotics. Also, there were more practical uses of working as a team to achieve a common goal which is useful when working in industry.

Appendix

Links to simulations and videos

[1] How to play Blackjack (Youtube): https://www.youtube.com/watch?v=eyoh-Ku9TCI

[2] Player's turn simulation (Tinkercad): https://www.tinkercad.com/things/if9RfiHMDYn-players-turn/editel?sharecode=MlIo78VxUoLTYB0DEEr3stTVl7kw8l94jiryBXXuaeQ

[3] Shuffle function simulation (Tinkercad): https://www.tinkercad.com/things/cnCxEGSYsru-card-shuffler/editel?sharecode=ZKb9dUSUnsQkBu6UktdpvSR3lFuSgtIZNaGAasIfwEY

[4] Twist function simulation (Tinkercad): https://www.tinkercad.com/things/cnyCLA5XMz6-twist-button/editel?sharecode=MgfRT9i9fTv1LWup0pF9ME9KuZqtsc6i41prwbk0tFE

[5] Stick function simulation (Tinkercad): https://www.tinkercad.com/things/e3lI7BzA51u-stick-button/editel?sharecode=mc5tsrfSk5LuOBfrE7Ans9E9WlVN5z3PUBgqWT4eFZA

[6] Navigation Simulation Gazebo: https://app.theconstructsim.com/#/l/3debea4c/

Meeting's Minutes

Meeting Minutes			
Group Name:	Robotics Project	**Group Number:**	2
Week:	7 (24/02/2021)		
Time:	13:00		

Place:	Microsoft Teams
Present:	Mark Hoy Ainhoa Arnaiz Callum Stewart Iain Bowman Zeon Ojuoko Kieran Hennessy
Apologies:	-
Agenda:	To discuss initial ideas for the project and agree on which game we will implement.
Review of previous actions:	No previous actions.
Main business:	Discussions were held for game choice and general project ideas.
Action:	Everyone to come to the next meeting with a game idea.

Meeting Minutes			
Group Name:	Robotics Project	**Group Number:**	2
Week:	7 (26/02/2021)		
Time:	13:00		
Place:	Microsoft Teams		
Present:	Mark Hoy Ainhoa Arnaiz Callum Stewart Iain Bowman Zeon Ojuoko Kieran Hennessy		
Apologies:			

Agenda:	Decide which game we are going to implement into our project.
Review of previous actions:	Everyone to come to the next meeting with a game choice.
Main business:	A vote was held for game choice in which Blackjack was the agreed-upon game.
Action:	Create a Gant chart for the project.

Meeting Minutes			
Group Name:	Robotics Project	**Group Number:**	2
Week:	8 (03/03/2021)		
Time:	14:00		
Place:	Microsoft Teams		
Present:	Mark Hoy Ainhoa Arnaiz Callum Stewart Iain Bowman Zeon Ojuoko Kieran Hennessy		
Apologies:			
Agenda:	Discuss systems involved in the game and robot navigation.		
Review of previous actions:	Create a Gant chart for the project.		
Main business:	Completed Gant chart after discussing project systems and decided on using ROS navigation.		
Action:	General research into project systems.		

Meeting Minutes

Group Name:	Robotics Project	**Group Number:**	2
Week:	9 (08/03/2021)		
Time:	14:00		
Place:	Microsoft Teams		
Present:	Mark Hoy Ainhoa Arnaiz Callum Stewart Iain Bowman Zeon Ojuoko Kieran Hennessy		
Apologies:			
Agenda:	Review how project systems will work and their design.		
Review of previous actions:	General research into project systems.		
Main business:	General review of project systems and assigned design tasks for various systems.		
Action:	Start design of systems involved in the game.		

Meeting Minutes			
Group Name:	Robotics Project	**Group Number:**	2
Week:	9 (10/03/2021)		
Time:	14:00		
Place:	Microsoft Teams		
Present:	Mark Hoy Ainhoa Arnaiz Callum Stewart Iain Bowman		

	Zeon Ojuoko Kieran Hennessy
Apologies:	
Agenda:	Update group on progress.
Review of previous actions:	Start design of systems involved in the game.
Main business:	Group updated on individual progress and discussions held as to changes that needed to be made. Review of the design prototype.
Action:	Continue development of card shuffle, card recognition, and card manipulation systems.

Meeting Minutes			
Group Name:	Robotics Project	**Group Number:**	2
Week:	10 (17/03/2021)		
Time:	14:00		
Place:	Microsoft Teams		
Present:	Mark Hoy Ainhoa Arnaiz Callum Stewart Iain Bowman Zeon Ojuoko Kieran Hennessy		
Apologies:			
Agenda:	Update group on card shuffle, card recognition, and card manipulation development.		
Review of previous actions:	Continue development of card shuffle, card recognition, and card manipulation systems.		

Main business:	Group update on progress made and decided on system changes needed for practicality.
Action:	Continue development and implement changes.

Meeting Minutes			
Group Name:	Robotics Project	**Group Number:**	2
Week:	11 (24/03/2021)		
Time:	14:00		
Place:	Microsoft Teams		
Present:	Mark Hoy Ainhoa Arnaiz Callum Stewart Iain Bowman Zeon Ojuoko Kieran Hennessy		
Apologies:			
Agenda:	Review completed systems and discussed any final changes to be made, consider player input, and play hand function development.		
Review of previous actions:	Continue development and implement changes.		
Main business:	Completed systems reviewed and ideas for changes put forward, discussed, and assigned play hand and player input function development.		
Action:	Make any final changes to the developed systems and start player input and play hand function development.		

Meeting Minutes			
Group Name:	Robotics Project	**Group Number:**	2
Week:	11 (26/03/2021)		

Time:	14:00
Place:	Microsoft Teams
Present:	Mark Hoy Ainhoa Arnaiz Callum Stewart Iain Bowman Zeon Ojuoko Kieran Hennessy
Apologies:	
Agenda:	Review finalized systems, update on player input and play hand functions.
Review of previous actions:	Make any final changes to the developed systems and start player input and play hand function development.
Main business:	Reviewed finalized systems and no changes to be made, marked as complete. Group updated on player input and play hand functions.
Action:	Continue development of player input and play hand functions.

Meeting Minutes			
Group Name:	Robotics Project	**Group Number:**	2
Week:	12 (02/04/2021)		
Time:	14:00		
Place:	Microsoft Teams		
Present:	Mark Hoy Ainhoa Arnaiz Callum Stewart Iain Bowman Zeon Ojuoko Kieran Hennessy		

Apologies:	
Agenda:	Review completed player input and play hand functions and discuss any final changes to be made.
Review of previous actions:	Continue development of player input and play hand functions.
Main business:	Group updated on player input and play hand function progress, review of completed work, and discussion held for improvements and changes.
Action:	Finalize player input and play hand functions.

Meeting Minutes			
Group Name:	Robotics Project	**Group Number:**	2
Week:	13 (07/04/2021)		
Time:	14:00		
Place:	Microsoft Teams		
Present:	Mark Hoy Ainhoa Arnaiz Callum Stewart Iain Bowman Zeon Ojuoko Kieran Hennessy		
Apologies:			
Agenda:	Review finalized functions and discuss their implementation.		
Review of previous actions:	Finalize player input and play hand functions.		
Main business:	Reviewed finalized systems and no changes to be made, marked as complete. Discussed how the project report will be compiled.		
Action:	Assign writing tasks to compile the report.		

Meeting Minutes			
Group Name:	Robotics Project	**Group Number:**	2
Week:	14 (14/04/2021)		
Time:	15:00		
Place:	Microsoft Teams		
Present:	Mark Hoy Ainhoa Arnaiz Callum Stewart Iain Bowman Zeon Ojuoko Kieran Hennessy		
Apologies:			
Agenda:	Update on the finalized report and writing progress.		
Review of previous actions:	Assign writing tasks to compile the report.		
Main business:	Discuss any changes to be made to the report and update group members on current report writing progress. Agree on a date for the video presentation.		
Action:	Continue report write-up and prepare for video presentation.		

Group 2 Robotics Project

Select a period to highlight at right. A legend describing the charting follows.

Period Highlight: 1

Plan Duration | Actual Start | % Complete | Actual (beyond plan)

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Gantt Chart	24-feb	2	24-feb	1	100%
Robot Navigation	24-feb	7	24-feb	1	100%
Card Shuffler	01-mar	7	08-mar	6	100%
Player input	01-mar	7	26-mar	8	100%
Card Manipulation	06-mar	14	08-mar	16	100%
Dealer's Turn	06-mar	14	08-mar	16	100%
Card Recognition	06-mar	28	08-mar	16	100%
Play Hand	08-mar	8	26-mar	8	100%
Report Writing	15-mar	8	14-abr	8	100%
Video Recording	29-mar	7	19-abr	3	100%
FPGA assingment	19-feb	15	19-feb	15	100%

PERIODS

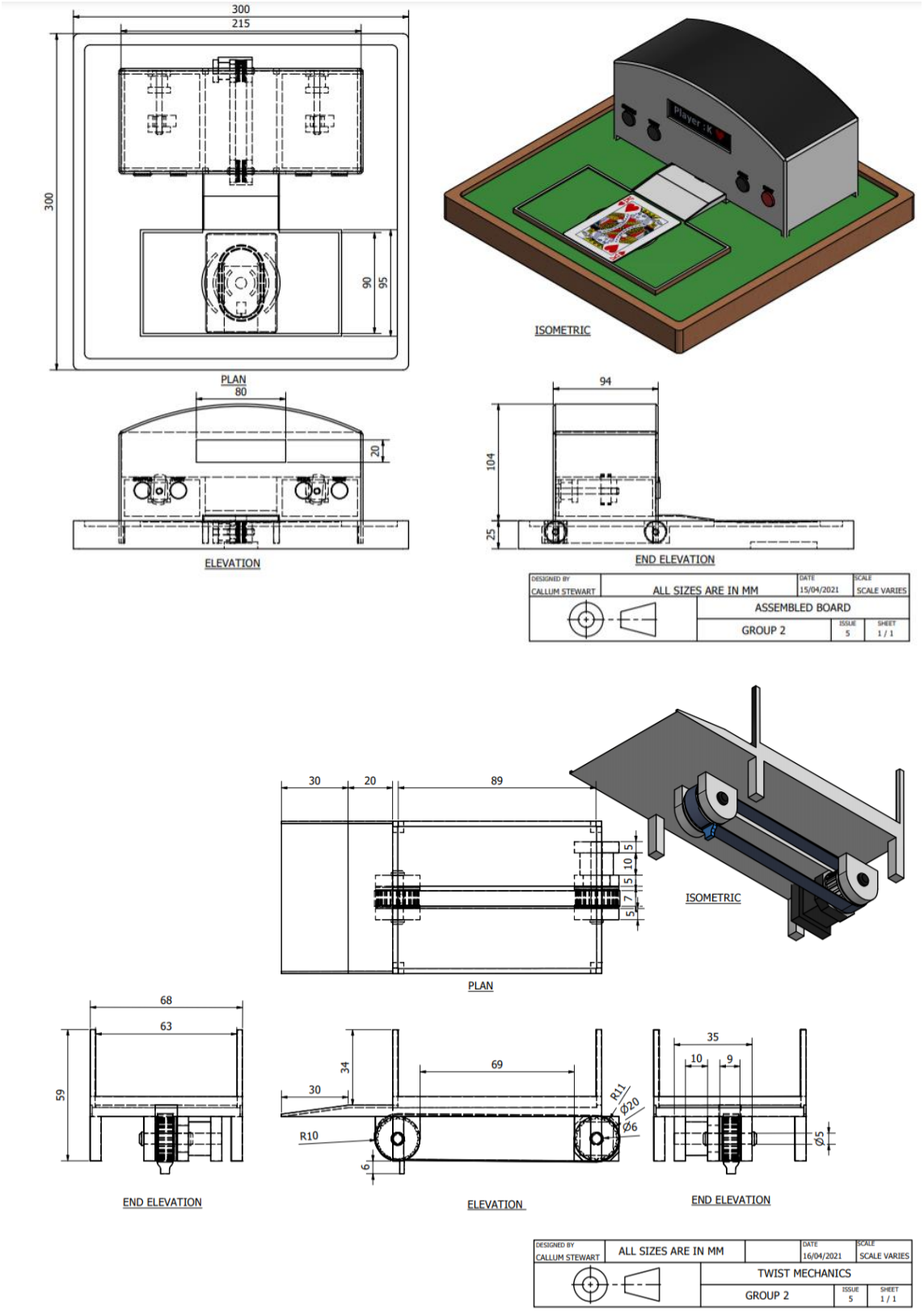
19-feb 20-feb 21-feb 22-feb 23-feb 24-feb 25-feb 26-feb 27-feb 28-feb 01-mar 02-mar 03-mar 04-mar 05-mar 06-mar 07-mar 08-mar 09-mar 10-mar 11-mar 12-mar 13-mar 14-mar

% Complete (beyond plan)

15-mar 16-mar 17-mar 18-mar 19-mar 20-mar 21-mar 22-mar 23-mar 24-mar 25-mar 26-mar 27-mar 28-mar 29-mar 30-mar 31-mar 01-abr 02-abr 03-abr 04-abr 05-abr 06-abr 07-abr 08-abr 09-abr 10-abr 11-abr 12-abr 13-abr 14-abr 15-abr 16-abr 17-abr 18-abr 19-abr 20-abr 21-abr 22-abr

Gantt Chart

Orthographic CAD Drawings



Peer reflective assessments

Ainhoa Arnaiz

In these years as a student, I have worked on internships and shared projects with other students, but this was the first time where I had the opportunity of having such a large, multicultural and, due to the pandemic, remote team. Quite a learning experience.

I have to say that a team project always generates concern and mixed emotions, because, on the one hand, it combines the wealth of contributions, ideas, and work of each person, making the final result possible, but, on the other hand, there may be tensions due to the lack of agreement in certain decisions or due to differences and imbalances in ambition, expectation, commitment and/or effort.

However, this time, the organization and group dynamics have been very fluid throughout the project. On the one hand, we have met regularly, approximately once/twice a week, and we have made a balanced distribution of tasks and effort. On the other hand, each person has been making their contributions of ideas, skills, and work, which has contributed to the project taking shape little by little.

I feel very grateful to everyone on the team because without their contribution the project would not have been possible. Right now, I could say that we are satisfied with the work done, expecting to achieve a good grade, and, above all, excited about the possibility that our project could be applied to real-life in the future. I wish we would make such an interesting solution happen.

Callum Stewart

Practical projects in university are by far the most rewarding things that a student will do. This group robotics project, where we were asked to create a game that would be carried out by a robot is certainly one of the most enjoyable tasks which I have taken part in throughout my university experience. The general skills we have learned whilst at university can all be combined into one, with a result that you can be proud of, as well as seeing that everything that you learned coming together to produce concepts that can help in society. The countless new skills and techniques, regarding animation and simulation, which were required in conducting the project will most certainly be helpful in the final few years and the rest of our careers. Each member of the team took equal responsibility in the project, whether it was taking time and care on the section allocated to them, or if it was helping another team member when problems were encountered. The group showed a desire to make the best possible product, and this really paid off in the latter end of the project. The group was extremely friendly, and all expressed great ideas throughout the project which made it even more enjoyable. Overall, the five members of my team should all be proud of what we have accomplished.

Iain Bowman

Practical projects are one of my favourite 7things to do at university and one of the reasons I choose an engineering subject, so it was disappointing when covid-19 stop us from doing practical work. However due to the hard work of our lectures and the quick adaptation of our group the project was an enormous success and surprisingly very enjoyable. My part in the project was to compare the results from physical cards. With the help of my team, we decided on using RFID chips and I created a simulation on how they would be used to get the final result of the game. Coding in C++ was relatively new to me having only used it once before in my first year, but it was amazing how fast I picked it up I think mainly due to having coded in many languages before. I loved the way this project challenged

me like this, having me learn new skills. My group members were extremely helpful and were always there to lend a hand or give advice when needed and I think that is what makes our project work so well as it felt like we worked as one. Overall, this was a great project it helped me learn new skills and become more familiar with working as a group especially when meetings and work are done remotely for whatever reason. This team has done amazing, and I am proud of what we have accomplished depside our circumstances.

Kieran Hennessy

I was not too optimistic about this course at the start as I think that group work can sometimes result in a final product that is a small part of everyone's overall ideas and doesn't make sense when it comes together. This is because it's hard to incorporate conflicting opinions into a single project as described by the expression, "a camel is a horse designed by a committee". However, I was pleasantly surprised during this course as everyone in our team was good at communicating their ideas and worked efficiently together.

In the beginning, we voted on which game we were going to base our project around; I think there was a lot of potential for some cool ideas but as I stated earlier any ideas that were too specific would not turn out great as everyone will have their own vision in their mind and the final product would be a mash-up. After a few ideas we voted on blackjack as our game of choice and looking back I think this was a great idea and worked well for us.

In an early stage of our meetings, we made sure that everyone knew their role within the group and made sure that barriers were put in place to keep us on the right track throughout the project. Everyone conducted themselves very well in their role and this helped our team crack through the work quickly and efficiently while creating a stress-free environment in which we could all comfortably work. Although we did work extremely well nothing is perfect and I think that we could have benefitted a lot more by being able to use and work with hardware to design and create our system.

Overall, I am extremely happy with our final project and report, and I had a great time working with this team and would be more than happy to work with them again.

Mark Hoy

This project more than any so far has really suffered from covid restrictions. From the start, it was clear that many elements of the project would have to be scaled back as a result of working remotely. Despite this, I think that our group adapted well, meeting regularly on Teams and making the best of a bad situation. There was the occasional struggle with the problems that arise with working remotely but we all took this in stride and adjusted accordingly. Having the professor available for weekly meetings really helped us to stay on track and, in the early days, clear up some misconceptions about the nature of the project. My main contribution to the project (besides general co-operation on aspects that the whole team contributed to) was to write some code for the robot to use to take the place of a blackjack dealer. The code is relatively basic because the system does not have to generate random cards (handled by a physical deck of playing cards) and because dealers in blackjack must follow very specific rules when taking their turn. Overall, I enjoyed the project but can definitely see how it would have much more engaging if we were able to work with actual hardware to develop our system and had to deal with the unique problems that making something in the real world can present. The team was the best I have worked with so far in my university career. Everyone was motivated and cooperative and I would be glad to work with any or all of them on future projects.

Zeon Ojuoko

This entire experience with the Robotics group project has been an enriching experience. I have learned a wide range of skills that will positively impact my life while enjoying every moment along the way, this mainly includes how to construct and code an Arduino system and working within a team. I have made strong connections with five enthusiastic engineers that have the spirit to achieve their goals. Every afternoon on Monday, Wednesday, or Friday, we would meet up on teams and discuss the tasks in a relaxed environment. The structure of every session was organized because the tasks were clear and concise, where we all remained focused on what we needed to accomplish for that week. The members in group 2 were considerate to everyone in the team because it was encouraged to express any ideas while being supportive to anyone in need of help. Whenever a problem came up, the team would be understanding and work together to find the solution. An example would be Callum Stewart helping to create the robot design on CAD or Ainhoa Arnaiz finding the solution to finally work the shuffle function on the Arduino. This strong communication created an authentic work ethic where teamwork was incorporated to overcome obstacles while nobody was left behind. Overall, the appreciation felt for the team has been indescribable, especially when performing the presentation. This was an enjoyable part of the journey because it gave the feeling of satisfaction knowing that the teams' efforts and collaboration have paid off in producing and demonstrating an amazing product.