Team "ACES"

Deliverable E

GNG 1103

Group GO1-1

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Abstract

This deliverable will include an in-depth detailed look at the materials and costs associated with our current final design that was selected in the last deliverable, which was based upon the general design criteria, as well as a detailed design drawing. We have also updated the Gantt chart in Wrike with a detailed roadmap of individual and group tasks for the coming weeks. Each task is assigned to each individual team member for the completion of the final product. We have concluded that the final invoice for our project will be $ 4.90.

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1. Introduction

This deliverable will feature a detailed design drawing and summary of our first design. Using Unity and OpenCV, a Windows application will be created. This application will take input from a camera mounted ~12 feet above the court and allow the user to view the ball's position as the game is played. All designs were specified from the design criteria and the concept was benchmarked against other products currently in the market to create an optimal final project that will exceed expectations. This deliverable will focus on project costs, component tools, project task plan, and finally will include a test plan for prototype one.

2. Detailed design concept

After meeting with the client our final design will be a windows application that uses live on court camera input to track the ball and create a file that can then be viewed later in the same software. As a starting point our app will expect the user to place a central camera above the court for simplicity. If there is time later, more functions can be added so the user can choose from a variety of camera configurations best suiting their courts' needs. Object oriented programing and documentation for each class and function will be included so the client can further develop the app later. The app will feature functions to create a game save file in .csv and replay the game using the csv file in unity.
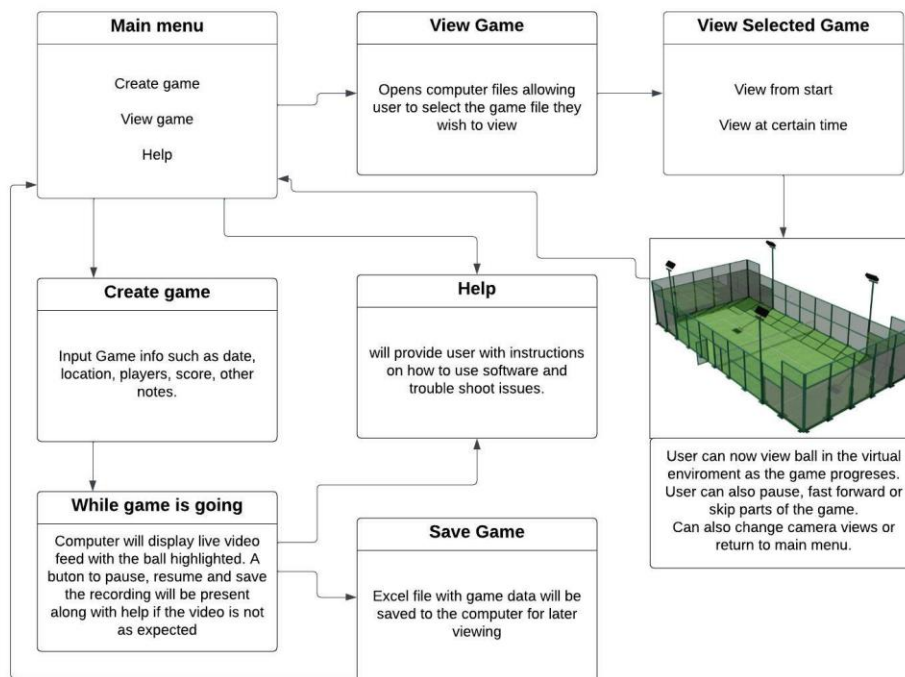

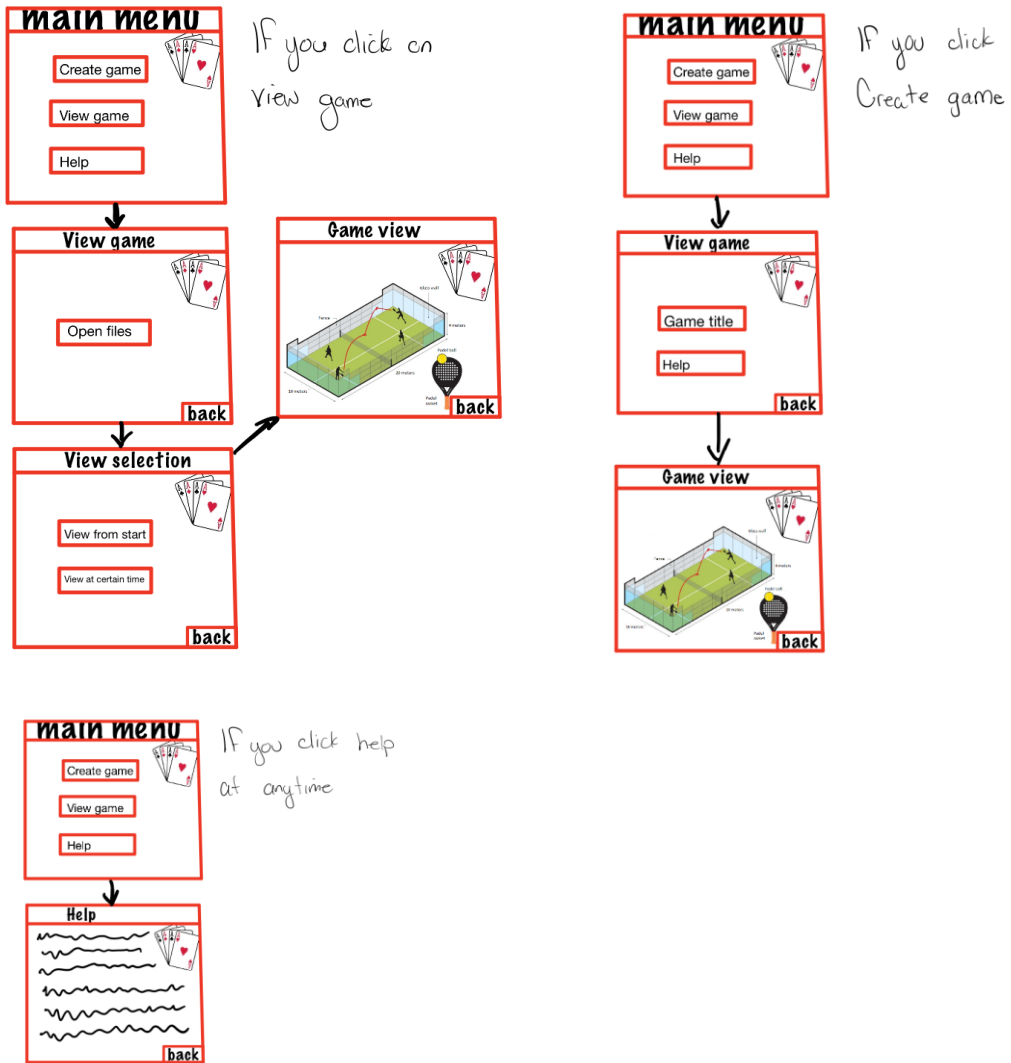**Figure 1:** *A flow chart of program menu sequences.*

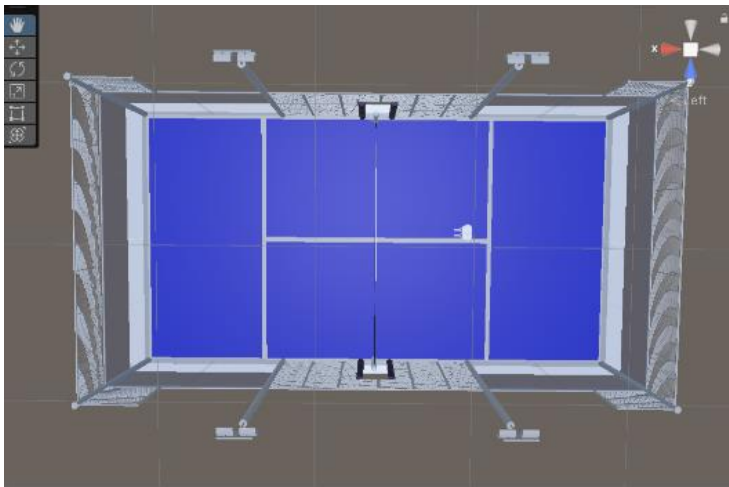**Figure 2:** outline of the app

Figure 3: 3D unity view of the angle that the camera will capture.

When the user starts to create a game, they will first be prompted to answer questions such as game date, location, players, and other notes, if time permits, they will also be prompted to select a camera configuration. Once the user answers the questions or skips them, they will then see the live video of how the computer is interpreting the court, the screen will be all black except the ball that will be highlighted in yellow. The user can then click recorded and a red dot will appear in the top right corner indicating that live recording is ongoing. There will also be buttons at the bottom to finalize and save the recording or temporarily pause it. To finalize the creation of a new game file the users' files will open for them to see the csv's file location and name. A 1080p 60FPS wide angle lense camera placed 12m above the court will be the base camera configuration. Hardware is left to the user as specified by the client in client meeting two.
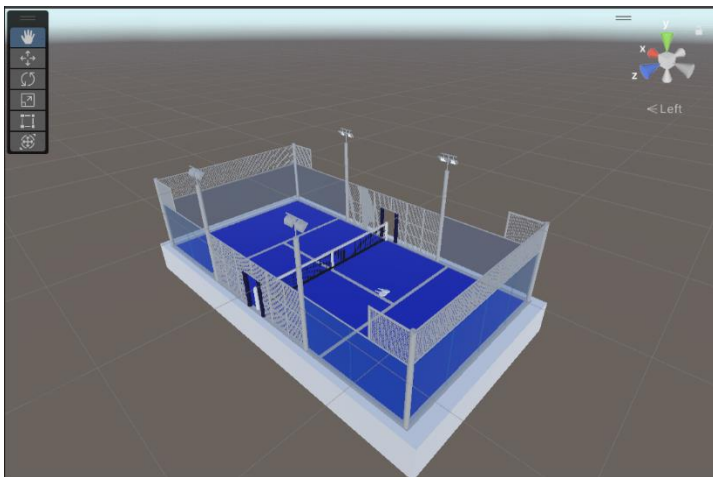

Figure 4: 3D unity environment where games are replayed

After the user selects a file to view, they will see the virtual environment as seen above. A yellow ball object will then move through the play field based on the save file selected. As the ball moves the user will be able to zoom in and out with a scroll wheel or change their point of view similar to how an object may be viewed in solid works. If time permits, we may add special commands for special preset viewing orientations. The user will have options to pause, return to the menu or skip to a different part of the game similar to a video player. The resolution and frame rate will be dependent on the computer the client is using as unity has built-in features to optimize graphics.

Class: game
- Game title/ info
- Playing field
- Ball paths[]

- Create new game()
- Load saved game()
- Edit game()
- View game()
- View game when()
- View game info()

Class: ball path
- Total time
- X path
- Y path
- Z path

- Create new path()
- Edit path()
- View path()
- Get ball speed()
- Get ball direction()
- Get position()

Figure 5: *main classes for the game*

OpenCV will use what the camera captures and store it as groups of coordinates to a csv file in order to track the position of the ball with respect to time, this will be coded in Python 3.10. Using the grouped coordinates, we can then create functions for the X, Y, and Z position of the ball with respect to time. Class Game will store and array of the position functions aswell as the selected court model and game info. This means that in the future if the client wishes to add more cameras or move the camera only the method of creating the coordinates needs to be changed. This also allows any other desired feature to be easily added. The portion to view the game will be coded in unity with C#.

3. Economics: Project costs and Component/Tool Selection

Part #	Part Name	Description	Quantity	Unit Cost	Cost (CAD)
1.	Graphics design template (Shutterstock)	Big collection of stock pictures, videos and editorial content	1	$0.22–$4.90/image	$0.22-$4.90/ image
2.	Ping pong table (paddle ball)	The ping pong table will be used for testing purposes	1	$0	$0
3.	Phone	We will record the motion of the ball with the use of a phone camera	1	$0	$0

4.	Camera app	The camera app on our phone will record the Padel ball	1	$0	$0
5.	Tripod	The phone will be set up on a tripod in order to record the motion of the Padel ball	1	$0	$0
6.	IV cam pro	App that wirelessly livestreams phone camera feed to a computer	**1**	$0	$0
7.	OpenCV	Python library that can do live tracking of an object	1	$0	$0
8.	Unity	Development platform that will be used to view the game	1	$0	$0

Table 1: Bill of materials

Highlighted in green will be the items used in the final product.

4. Design Project Task Plan

Wrike link:
https://www.wrike.com/workspace.htm?acc=4975842#/folder/968841774/timeline3?viewId=109685302

Wrike snapshot:
https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=JVRizET3nzctf5sjpyPaH2jbBXhU1U2r%7CIE2DSNZVHA2DELSTGIYA

5. Test plan (prototype 1)

Introduction/ Objective:
Track a Padel ball on a virtual platform to be able to determine the balls location in the real world.

Test items:
Since we don't always have access to Padel ball courts, we will be using a Ping Pong table (or a substitute) with ping pong balls and ping pong racquets to depict the idea of using a Padel Ball court in real time. Currently, we have a Lenovo IdeaPad Flex 5, with Microsoft Windows 11 Home operating system. We will be using OpenCV, unity, IV cam to capture this project.

Features to be tested:
- Speed of ball
- Position of ball
- Where the ball will be situated in the space at a given time
- Full analysis of the game

Approach:
Use the listed test items, generated codes and download specific software's to compile a program that will test a ping pong balls location, speed, and position in the final product.

Item pass/fail criteria:
PASS:
The software will be able to track the ball on the computer and depict the position as it is in real life.

FAIL:
The software fails to track the ball on the computer and depict the position as it is in real life

6. Contingency plan

Below are the outlined risks for our project and the contingency plans derived to get the project back to its original pace. The contingency plans and their associated risks are outlined in order of most likely to least likely to occur. All risks will be carefully analyzed by the group when time comes and if needed, the contingency plan will be analyzed in greater detail based on subject-specific risk. The following table shows the final contingency plan.

Likeliness to occur	Risk	Risk association	Contingency plan
1 (Very high)	Time limitations due to schedule conflicts between groupmates	- Exceeding due dates - Poor quality of work - Poor communication	- Use group chat as much as possible - Ensure course work will not interfere with personal commitments
2 (High)	Problems with compiling of code	- Unusable product - System errors - Incorrect data transfer	- Work with the TA's and have them help as much as possible - Do online research
3 (Likely)	Group conflict	- Very poor final product - Unnecessary arguments - Poor teamwork	- Ensure all group members have equal say - Work with each other to understand final goal
4 (Unlikely)	Improper design/ losing work	- Improper/unfinished final product - Unusable final product	- Check with TA's and connect with clients to ensure proper progress - Ensure all work is saved so there is no loss

7. Conclusion

Shown above is a detailed design plan. It includes a layout for the app, and a flow chart for how the app will function after the coding has been completed. As well as a 3D model of the Padel ball court from side view and birds eye view. This is where we will be setting up the cameras in real life, so that the game can be previewed during and after the match. Finally, we Created a bill of materials and test plan for what our process should look like moving forward.

8. References

About your guide Matic Broz LinkedIN Email Instagram Matic Broz is a photographer, Matic Broz LinkedIN Email Instagram, Broz, M., LinkedIN Email Instagram, & photographer, M. B. is a. (2022, September 4). *Shutterstock Review (2022): Pros, Cons, prices*. Photutorial. Retrieved October 21, 2022, fromhttps://photutorial.com/shutterstockreview/#:~:text=How%20Much%20Does%20Shutterstock%20Cost%3F%20Shutterstock%20offers%20subscriptions,while%20the%20Enhanced%20License%20for%20images%20costs%20%2467.96%E2%80%93%2499.50.