



Team “ACES”

Deliverable F

GNG 1103

Group G01-1

Team members

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Abstract

After meeting with the client and receiving feedback, a detailed first prototype was created. The feedback received was positive, showing that the initial idea for the project was a success and the current procedure can be continued. The previous deliverable included a cost estimate that will be used to budget funds for this project, which will be modified if needed.



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1. Introduction

The goal of this deliverable is to analyze the development of the first prototype. It will include the links between OpenCV, Unity, the code developed to analyze the motion of the Padel ball to track it during the games. This deliverable will include discussing the prototype, analyzing the given customer feedback, and testing the next steps. It will also contain vital information to make important decisions about the future success of the project (i.e: what needs to be changed, what needs to be added).

2. Plan for prototype 2

The Next prototype will build on the first one by using the current code to create software that has user friendly menus and can output the balls' location to a CSV file using the functions created in Prototype 1. This will then be read by the second part of prototype 2 that displays the ball in unity. Some of the prototype 1 testing will be done with prototype 2 as there were unexpected complications. To prevent this in the future deliverables will be started sooner.

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. Associates of group members will also be asked to navigate and use the menus to see if the user interface is clear and concise.

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. The generated code will be more user friendly. There will be no need to call methods and function manually. Users will be able to follow a more convenient set of directions to operate the final product.



To test the accuracy of software a ball will be moved around a ping pong table in a predictable manner and the output of the software will be compared to the true known position.

To test menus and interfaces random people will be asked to use the software and navigate to different features.

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. The movement of the ball should be clean and reasonable rather than jumpy and illogical. The ball's calculated position should be no more than 10% different than the true value.

90% of people tested will be able to navigate menus and find features in a short amount of time. As well as say the software is understandable and easy to use.

FAIL:

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

Users are unable to navigate menus and provide feedback that software is complicated or difficult to use.

3. Client Feedback

FEEDBACK	USE OF FEEDBACK
The clients suggested that the focus should be on the code and developing the code so that it works as efficiently as possible.	After receiving this feedback, our goals shifted slightly away from the design and layout of the app and the 3D space and is now geared toward testing out different codes. With this we can acquire the best possible code that can capture the location of the ball very clearly at any point throughout the match.
Keeping the code organized in case it develops and expands	This was something they mentioned that our group was already prepared for, this was more of a confirmation than a suggestion, we planned on this code being able to transfer over to any sport and not just be used for Padel ball.
ELABORATE: With the ping pong table The suggestion was to use a flat surface on the edge of the table to recreate what it would react like on a Padel ball court	The clients loved the idea we presented about using a ping pong table to scale for the Padel ball code, it was one of the key points they pointed out at the end during the discussion, they said that it would be good to use a flat surface on the end of a table in order to simulate what the effect would truly look like in a Padel ball math



4. Prototype 1

After Evaluating client feedback on the first design, it was understood that the key element of the project is creating software that can track a ball in live time through 3D space. The client also emphasized they would like the software to be able to receive inputs from multiple cameras and stated menus and ascetics are the least of their concerns. Thus, the focus of prototype 1 was creating classes and methods that can be implemented in the final project to store necessary information about a court's camera configuration and output the location of the ball in meters. This code is the most critical as it is the most difficult to conceptualize and create. The methods and classes are also the basis of the rest of the project. After completing this code, we are only left with creating a user-friendly interface and a unity code that can read a file and display a ball on a court. Preliminary research shows these components are relatively easy to create and are of less importance so most of the prototyping will not be focused on them. Prototype 1 features a camera class that stores the camera's position and orientation relative to the court. The class has multiple methods to get and modify information about the cameras which can be useful for both development and the final product. Most importantly, it has a method that returns the ball's position in meters. The court class stores an array of cameras and has primitive methods to add cameras which are useful for testing. It also features a method that gets the coordinates from each camera in the array and averages them (the main goal of the project). The results from this method will be stored in a CSV file and then can be later read by unity. The next step is to complete and test a second prototype by Sunday November 13 that features basic user-friendly menus and tests the true accuracy of the current prototype. Methods and classes should also be documented for later use or changes by us or the client. To see all the code created for prototype 1 view the attached CustomClasses.py.

5. Prototype 1 testing results

Due to time constraints, resource limitations, and miscommunications prototype 1 was not able to be tested as expected. To test the prototype we simply created a variety of both camera and court classes and called all critical methods from the terminal to ensure they worked. The criteria for a working method were that it did not raise an error and returned the expected result. After multiple rounds of testing in this manner all methods functioned as expected and returned the expected values. The actual ability of the software to approximate a ball's position was not tested as we had originally hoped. This will have to be moved back to be tested with Prototype 2. It is worth noting that the methods to find the ball's position were given some test inputs and returned logical results in the sense that the coordinates produced were positive and negative when expected and seemed to be of reasonable magnitude (no insanely large or small numbers). When 2 cameras were active and being calibrated it was found that the software was sometimes slow and choppy. Better optimization in prototype 2 will be needed to fix this. To view terminal test results view the attached prototype_1_test_results.txt.



6. Potential client/user feedback

After speaking with other students at the University of Ottawa (mainly from the Faculty of Engineering or Telfer school of Business) their understanding of our goals and what we are trying to achieve through this project was very clear. There were very little suggestions, most of the comments were either “this would be really cool if it was in my sport” or “I wish this was as easily accessible for people who play a sport, but don’t have lots of money.” It was clear that our project is very adaptive, in that, students believe it would be great if this came to their sport. Our goal is to create a code that works efficiently in collecting data for a Padel Ball game; However, we also want our code to be easily expandable so that it can fit into other sports with future development.

7. Updated target specifications, detailed design and BOM

After testing prototype 1 and the client feedback, it was decided that our current target specifications and BOM will remain the same. For the detailed design, our choice to purchase a texture for our application has changed. We have learned that it may not be necessary for our project to have this; However, if we do still choose to purchase a texture, it must first be cleared with a PM (Project Manager) or TA (Teacher Assistant).

8. Analysis of project components

Component	Analysis
OpenCV	- Analyzes the video from unity 3D space
Python	- Code is run and developed using this computer language
Unity	- Used to preview the 3D space where the code runs - Displays the match on the screen as it is happening
Ping pong table and ball	- The goal is to use a ping pong match (table, paddle, and ball) - Its job is to test the code and how it would look if it was scaled to the size of Padel ball court
Camera (phone)	- To capture the footage of the match
Camera stand	- To hold the camera
Prototype 1 code	- Store information about the camera setup and output the location of the ball.
Computer	- Include all the applications necessary for the project to work as expected - Stores all important aspects of the project



9. Conclusion

The feedback provided by our clients gave us a clearer idea of what should be incorporated in our first prototype. The clients did this by highlighting the ideas that we should pursue and further develop and by identifying which ideas may not be worth pursuing based on what they are searching for from our product. We also decided that our current BOM and target specifications did not need to be updated and we analyzed the components that will be used in our project.

10. Wrike

Permalink

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

Snapshot

<https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=GAoAw3nJ0yLGS57b2E7YDyRzhrzGTuj6%7CIE2DSNZVHA2DELSTGIYA>