Augmented Reality Application for training basketball shooting

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1 ELEVATOR PITCH

I will create an Augmented Reality application to improve the shooting skills of basketball players. The users will wear the Augmented Reality headset during the basketball training. And then, the application would calculate the best shooting path from the user's position to the hoop, and display a digital hologram of the shooting path with additional details like force, angle, and distance, etc. Furthermore, the application will record all of the shots and analyze how to adjust the users' shooting pose. For the goal, I hope this application can help users find their shooting problems and increase their field goal percentage.

Demo Video: https://www.youtube.com/watch?v=dhTCkRRkxpc

2 EXTENDED OVERVIEW

Accurate tracking between the user, ball, and hoop in 3D space is the most challenge part. The application needs to get the three 3D positions, the user, the hoop, and the ball to calculate the prediction shooting path. For the user's position, we can get the position data from the headset sensors. For the ball position, we can either use computer vision algorithm to do object tracking on the ball or have sensors inside the ball. For the hoop position, we can put a QRCode and get the distance relative to the camera on the headset.

For tracking the position of ball, the object tracking algorithm is not stable enough and may have miss-calculation for depth distance. Therefore, a better solution can be putting sensors into the ball, and track the ball with sensors. To make this application easier to implement, we decide to put the controller inside the ball, and get the ball's position from the controller.

After gathering 3 positions, we can predict the shooting path and display the hologram on the headset. However, based on the paper, The physics of an optimal basketball free throw, the author said that the best shooting angle is varied by the height of the players. Therefore, the algorithm for calculating shooting path should be dynamic based on the height of the users and the distance to the hoop.

2.1 Technical Challenges

This project involves addressing the following key technical challenges.

- I need to understand the physic of basketball
- I need to get familiar with Unity and AR headset
- I may need to learn OpenCV and implement it in Unity

2.2 Key Risks and Mitigations

We identify the following key risks and potential implementation alternatives.

- The most challenge thing is to get the accurate position of the ball. I may spend much time on figuring out the best solution for tracking the ball's position. Also, I am afraid that I may break the controller if I put inside the ball and throw it.

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- I may not fully implement the calculation of the best shooting path because it probably need a lot of testing and research. Therefore, I may just implement a demo version which only predicts certain angle like 45 degree.

3 HARDWARE AND SOFTWARE

This project requires the following hardware.

- [Requested] Magic Leap
- [Requested] Mini Basketball Hoop
  https://www.amazon.com/AOKESI-Indoor-Mini-Basketball-Balls/dp/B07SGX9VNY/ref=zg_bs_166455011_6?_encoding=UTF8&psc=1&refRID=RDC6P44PCK8NCF1PBPWT

This project requires the following software.

- [Personal] OpenCV
- [Personal] Unity

4 DEVELOPMENT PLAN

I aim to complete this project over three weeks(February 29 through March 19), with the following major milestones.

- **February 30**: Familiar with Magic Leap
- **March 1**: Get the position data of controller and headset in Unity
- **March 4**: Get the position data from QRCode
- **March 8**: Implement the calculation of shooting path and display the hologram in Unity
- **March 10**: Make the controller inside the ball
- **March 15**: Finish the application with UI, menu, and tutorial, etc.
- **March 17**: Complete and submit the final report.
- **March 18**: Prepare final project demo, including (optional) poster.
- **March 19**: Participate in the final project demo session.

5 REFERENCES

Irina Barzykina, 2017, The physics of an optimal basketball free throw, (https://arxiv.org/pdf/1702.07234.pdf)