Smart Snooker Description Stage

Author: Douglas O'Hanlon
Supervisor: Phil McMinn
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A brief overview into the background research and feasibility of the SmartSnooker project.

Introduction

The project involves the creation of a mobile application, which will help snooker players to improve. The main goal of the app is to use augmented reality to overlay potential shot trajectories on top of the camera's output.

The app will also aim to incorporate all the features outlined in the project brief, including:

- Realtime shot selection overlays
- Realtime shot execution overlays (optimal trajectory and predicted outcome)
- Interactive tutor character guide, explaining educational content on rules, strategies and shot options
- User friendly user interface
- Usability testing to ensure effectiveness and ease of use

The app should also be accessible and enjoyable to anyone wanting to improve their game.

Initial research found one mobile application called Billiard Radar, offering augmented reality shot guidance. The app is now discontinued, as stated by the developer Crudebyte [1]. The only information available on this app is a web page on the developer's website, describing it as "the very first augmented reality mobile app that assists you playing billiards" [1]. No dates of the app's release or discontinuation are mentioned, but devices such as the iPad 3 and iPhone 4 and 4s were once supported [1], which are all devices released between 2010 and 2012 Apple [2, Sec. iPad, iPhone]. Since these are the only supported devices mentioned, it suggests the app was not maintained or used much beyond this time. Furthermore steps of the setup process often must be repeated if lighting changes [1, Screenshot. iPad shot 4].

At this stage of research, no other augmented reality snooker or billiards helper apps could be found, meaning the project could deliver the only application of its kind available at this point in time. Plus the lengthy setup process of Billiard Radar may be an area that SmartSnooker can improve on with the recent advancement of phone cameras and augmented reality technologies.

There are existing augmented reality technologies for billiard tables, such as Capassa [3], MagixPool [4] and IQ Billiards [5], however these all require a ceiling mounted projector and

camera, meaning a player wanting to improve their skills would need to visit a venue with this technology already installed. SmartSnooker could offer a much more accessible solution by allowing players to simply download an app rather than needing to find a venue with a dedicated system installed.

Analysis

The application will involve a few key challenges. First converting the device's camera output to an internal model of the snooker table will involve computer vision techniques to identify the position of the table and the balls on it. Secondly a model of the physics and rules of the game will need to be created in order to calculate potential shots and their trajectories. Thirdly an algorithm for displaying these trajectories in augmented reality will need to be developed.

Developing the entire computer vision and augmented reality systems from scratch may be too time consuming for the scope of the project, so existing toolkits and libraries may be essential for the success of this project. Existing AR toolkits and development environments such as Unity's AR template [6] and Apple's ARKit [7] could aid in displaying objects in AR. These toolkits may only be of limited help when determining the position of balls though, for example ARKit's documentation mentions object detection, but only in the form of a planeDetection property for vertical and horizontal planes [7, Sec. ARKit in iOS, planeDetection]. This means the computer vision techniques to identify the position of balls may still need to be researched and implemented from scratch.

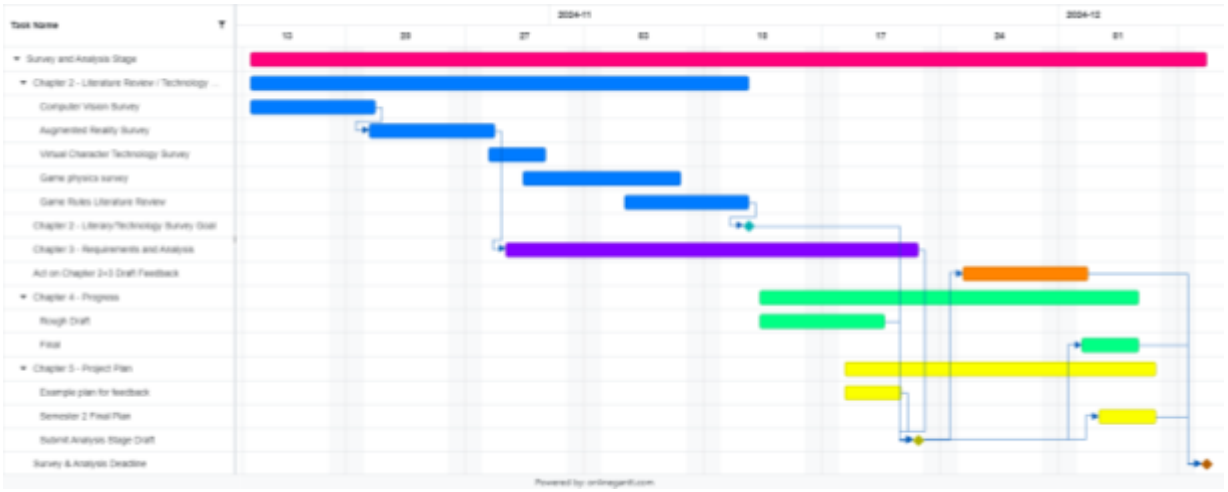
The physics of shot prediction is covered in Augmented Reality Billiards Assistant [8]. A Honors design project for a very similar concept. This paper concluded that "Use of spin and more accurate collision and ball movement models have been abandoned to make sure the project can be completed within one semester" [8, p.92]. Since this project is of a similar scope, it suggests implementing a physics model ignoring spin should be achievable given the time constraints of the project.

The application must also include the virtual character to display helpful tips, rules and other information. A character itself could be a relatively simple graphic, however integrating it with the current game state to give relevant hints and rules could be more complicated. A potential solution for this is to have a model of the game and its current state linked to a knowledge base of rules and tips applicable to certain situations/states.

Weekly Plan

Below is a gantt chart showing a rough plan of how time will be allocated over the Semester to complete the Survey and Analysis stage.

The initial focus will be on the technology survey for augmented reality and computer vision, as the available techniques and toolkits for making AR may affect the achievable requirements and plan of the project.



Survey and Analysis Stage Gantt Chart

Conclusion

In summary, initial research gives confidence that it is possible to create an application satisfying the project description within the timeframe. The next steps of the project should be to research in further detail computer vision methods and AR tools to use in development.

References

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[4] TouchMagix “Magixpool” TouchMagix https://www.touchmagix.com/products/magixpool (Accessed 7th October 2024)

[5] IQ Reality “IQ billiards” IQ Reality https://iqreality.com/ (Accessed 7th October 2024)

[6] Unity “AR mobile template quick start guide 1.0.1” https://docs.unity3d.com/Packages/com.unity.template.ar-mobile@1.0/manual/index.html (Accessed 9th October 2024)

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[8] S. Medved, T. Brady, J. Schooling “Augmented Reality Billiards Assistant” Honors research project, Williams Honors College, Univ. of Akron, USA, 2020. [Online]. Available: https://ideaexchange.uakron.edu/honors_research_projects/1104/