VR Plexus: Can Virtual Reality on a Smartphone Improve Neurology Learning Amongst Medical Students?

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Introduction

- **Stereoscopic virtual reality (VR)** creates immersive three-dimensional (3D) environments
- There is increasing interest in the application of VR technology to **anatomy and physiology education**[1-3]
- The best use of VR technology is for visualizing complex, 3D structures such as the brachial plexus
- **Costly VR equipment** is a monetary barrier to the uptake of VR which directly diminishes its use and stifles innovation[1]
- The following protocol describes a 3D VR production system, designed for **rapid-implementation and financial accessibility**

Objective

To create an **efficient and cost-effective method for developing a student-accessible, virtual reality (VR) resource** to improve anatomy and physiology education.

Protocol

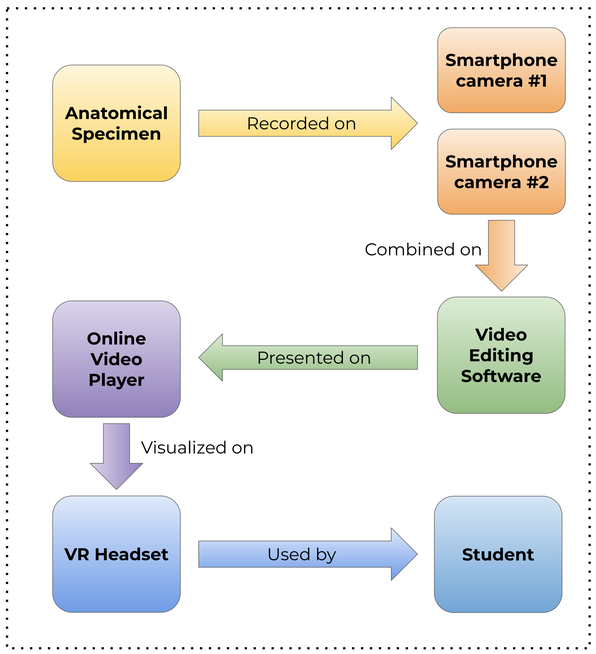

Figure 1 - Production Process
The process of rendering the anatomical specimen in stereoscopic VR. Possible with accessible mobile phones, video software, and low-cost Google Cardboard headsets.

Results

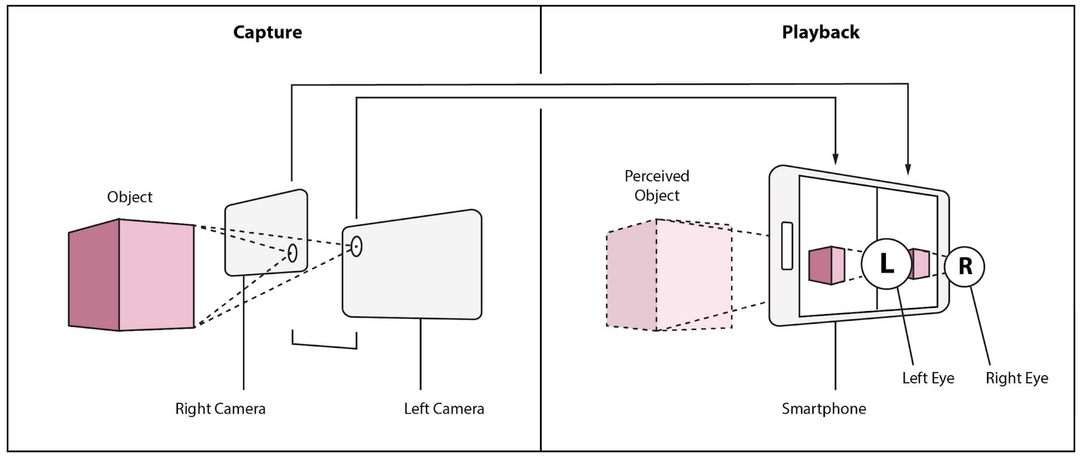

Figure 2 - Virtual Reality Setup

- Stereoscopic videos, filmed on two mobile phones, allow movement of the object and animations for education (e.g., labels, highlights)
- Individual 3D stereoscopic images can be created using a brief video pan of a specimen (not shown) (example application: Camarada)
- The Google Cardboard VR headset is a cost-friendly means for displaying stereoscopic imagery

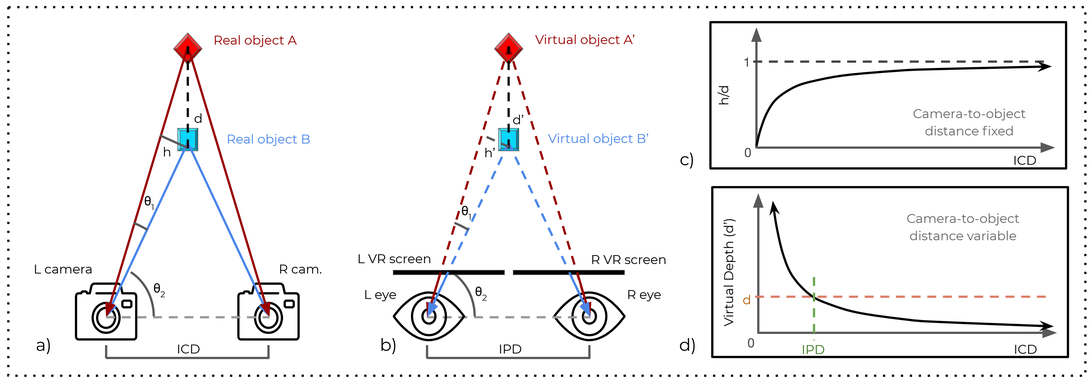

Figure 3 - Models of Visual Depth Perception
(a) Stereo camera setup. ICD = inter-camera distance (distance between lenses), d = real distance between real objects A and B, h = visual projection of d. (b) VR headset setup. IPD = inter-pupillary distance (distance between pupils), d' = user's perceived distance between virtual objects A' and B', d' = visual projection of d'. (c) Mathematical model of visual depth (d') as a function of ICD. (d) Mathematical model of stereoscopic parallax measured as the ratio of h/d as a function of ICD.

- By placing cameras at an ICD similar to IPD, the virtual depth d' will approximate the real depth d
- Stereoscopic parallax (Fig. 3.c): Increasing ICD provides additional lateral and asymmetrical information to each eye, causing a 'pop-out' effect
- Visual size (Fig. 3.d): Decreasing ICD while bringing the cameras closer to the objects (i.e. Real Objects A & B) to keep the angles θ_1 and θ_2 constant can simulate increased visual depth (d')

Discussion

VR Brachial Plexus Module

- Watch the VR Brachial Plexus module on your smartphone by scanning this QR code:

General VR Recommendations

- To change VR depth, the ICD and/or the camera distance to objects filmed can be modified
- Due to different IPD and phone screen sizes between individuals, multiple videos may need to be created to accomodate this variability, with varying distances between left and right videos

Protocol Advantages

- The production process is readily available to many university students and faculties, demonstrating the cost-effectiveness and technological-feasibility of such a system, which allows it to be implemented with numerous anatomical specimens

Protocol Limitations

- Rendering the video side-by-side may change the spacing and size of the video when viewed on phones with different screen dimensions

Conclusions

- It is possible to complete a financially-accessible yet effective smartphone VR process in the interest of teaching medical students anatomy
- This project provides insight regarding the design and use of VR in anatomy and physiology education

Further investigation

- This tool will be used in an upcoming randomized control trial on the effects of stereopsis on neuroanatomy and physiology education
- The effect of modifications of the ICD and camera distance to objects on stereoscopic depth invites further investigation

Acknowledgements

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