LabDesignAR: Configuring Multi-Camera Motion Capture Systems in Augmented Reality

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ABSTRACT

We present LabDesignAR, an augmented reality application to support the planning, setup, and reconfiguration of marker-based motion capture systems with multiple cameras. LabDesignAR runs on the Microsoft HoloLens and allows the user to place an arbitrary number of virtual "holographic" motion capture cameras into an arbitrary space, in situ. The holographic cameras can be arbitrarily positioned, and different lens configurations can be selected to visualize the resulting fields of view and their intersections. LabDesignAR also demonstrates a hybrid natural gestural interaction technique, implemented through a fusion of the vision-based hand tracking capabilities of an augmented reality headset and instrumented gesture recognition with an electromyography armband. The source code for LabDesignAR and its supporting components can be found online.

CCS CONCEPTS

• **Human-centered computing → Mixed / augmented reality**;
• **Applied computing → Computer-aided design**;

KEYWORDS

LabDesignAR, motion capture, augmented reality, HoloLens, gestural interaction, natural interaction

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1 INTRODUCTION

Marker-based motion capture with multiple cameras is a technology that enables precise position tracking for a variety of applications. These include animating characters for movies and games; sports performance analysis, the diagnosis and treatment of musculoskeletal and neurological disorders, and closed-loop control of mechatronic systems, among others. Motion capture can also power immersive virtual and augmented reality (VR/AR) systems such as "free-roaming" gaming setups, where precise tracking is required for multiple bodies over large distances [Bloem 2017].

During motion capture measurements, physical markers (e.g. reflective spheres) are attached to the subject, which must always be visible to at least two cameras. ('Missing' markers will cause 'gaps' in the data, which must be corrected during post-processing.) Ensuring adequate coverage is important when planning a new motion capture setup, or when reconfiguring an existing system (cf. [Allen and Welch 2005]). Care must be taken to choose the correct hardware and positioning, taking into account the expected movement patterns and the constraints of the space. For this purpose, recently, vendors of motion capture equipment provide interactive web applications that let users build a basic model of their capture environment and experiment with camera placement[1]. Designs created with these applications can serve as blueprints for subsequent sales and installation processes. Moreover, cameras may be moved, added, or removed after the initial setup. This also can be laborious, since cameras can be difficult to reach (e.g. high or underwater) and must be secured tightly after each adjustment.

To address the challenges in planning and reconfiguring multi-camera motion capture systems, we designed and developed LabDesignAR – an AR application to support the selection, placement, setup, and reconfiguration of marker-based motion capture systems with multiple cameras. LabDesignAR runs on the Microsoft HoloLens and allows the user to place an arbitrary number of "holographic" motion capture cameras into a real, arbitrary space. The cameras can be arbitrarily moved and rotated, and different lens configurations can be selected to visualize the resulting frusta and capture volume coverage.

LabDesignAR demonstrates an AR-based solution to challenges in a field that serves to enable VR/AR applications. It also demonstrates a 'hybrid' technique for natural gestural interaction [Yin and Davis 2010], where the user's hands are tracked using an electromyography (EMG) sensor worn on the forearm, along with the depth cameras on the AR headset. The application and its source code are freely availabe online[2], under a permissive license. The components used in the application to enable networking between a motion capture system[3], an EMG armband[4], and an AR headset[5] are also similarly open-sourced.

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[1] E.g.: labdesigner.qualisys.com
[2] github.com/mbaytas/LabDesignAR
[3] github.com/mbaytas/QualisysUDP
[4] github.com/mbaytas/MyoUDP
[5] github.com/mbaytas/HoloLensUDP