Augmented Reality See-Through Walls for Intuitive Patient Monitoring during an X-Ray Acquisition

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

Nurses and doctors often leave the operating theatre when acquiring X-Ray images or CT volumes. If lead-shielded windows are unavailable, cameras must be installed inside the theater. However, naive camera-monitor setups can be disorienting. The article proposes a system that imitates the experience of looking through a window into the theater. The student's task is to set up a camera-based system that intuitively lets outside viewers see inside the theater as if looking through a window. The system should detect users looking at the monitor and allow them to change their perspective.

Background and Motivation

The average radioactive dose required for X-Ray images and CT volumes is harmless; However, anyone working with them on a daily basis must take precautions. A common practice is to leave the room while the X-Ray device remotely initiates the acquisition routine. To continue monitoring and state of the patient and the X-Ray device, doctors wish to maintain the view into the operating theater. Often operating theaters are equipped with lead shielded glass windows, allowing them to do precisely this. Nevertheless, it may only be available in some places, and an installation post-construction or on short notice is impossible for obvious reasons. A simple yet effective way to circumvent this issue is to install a camera within the operating theater, in which the video stream is shown on a monitor outside. However, a camera monitor setup does not maintain spatial coherence, and people seeing the live feed may feel disoriented in hectic situations. Therefore, we endeavor to imitate the feeling of watching through a window into the operating theatre but with a camera-monitor setup. Related work has mainly investigated the use of Augmented Reality for outdoor see-through use cases [1, 2]. The concept of telepresence is not far-fetched [3] to remove the walls disconnecting two separated rooms.

Student's Tasks Description

The student's task is to set up a camera-based system, allowing people outside a room to see inside it in a visually intuitive manner. For conciseness, it is recommended to use a large monitor outside the room; however, other types to visualize an image, e.g., projectors, are appreciated when coordinated with the mentor. The visualized content should go beyond a simple replay of the camera stream. For example, a user standing in front of the monitor should be able to change their point of view, and the system should react accordingly. Therefore, the proposed setup should be aware of any users looking at the monitor, such as through a camera tracking the body pose of any observers. The recommended device is a Kinect camera or a regular webcam, from which the video stream is fed into body-tracking software (e.g., media pipe [4]). The camera installed within the operating theatre can be a regular webcam, fisheye camera, or an RGB-D camera.

The student will learn about techniques to manipulate image content for user-centered visualizations and the challenges in deciding the best-suited technology given a clear goal.

Technical Prerequisites

- Basic knowledge of stream-lined image processing, homography, and image projection
- Programming skills to realize the above-mentioned knowledge in image handling, e.g., python, Unity3D/C#
- Ability to turn creativity into a working prototype

References

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