

METHODS AND SYSTEMS FOR AUGMENTING DEPTH DATA  
FROM A DEPTH SENSOR, SUCH AS WITH  
DATA FROM A MULTIVIEW CAMERA SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION(S)

**[0001]** This application claims the benefit of U.S. Provisional Patent Application No. 62/963,717, filed January 21, 2020, and titled "METHODS AND SYSTEMS FOR AUGMENTING DEPTH DATA FROM A DEPTH SENSOR, SUCH AS WITH DATA FROM A MULTIVIEW CAMERA SYSTEM," which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

**[0002]** The present technology generally relates to imaging systems, and more specifically, to imaging systems for generating a virtual perspective of a scene for a mediated-reality viewer.

BACKGROUND

**[0003]** In a mediated reality system, an image processing system adds, subtracts, and/or modifies visual information representing an environment. For surgical applications, a mediated reality system can enable a surgeon to view a surgical site from a desired perspective together with contextual information that assists the surgeon in more efficiently and precisely performing surgical tasks. Such mediated reality systems rely on image data from multiple camera angles and depth information about the environment to reconstruct an image of the environment.

**[0004]** Depth information about the environment is typically obtained via a dedicated depth sensor, such as a structured light depth sensor. However, the capture of complex three-dimensional geometries using a structured light depth sensor requires that all surfaces of the environment be exposed to the depth sensor to acquire error-free and complete data. In practice, this is not feasible due to geometries and/or occluded surfaces hidden from the depth sensor.

SUMMARY

**[0004a]** In a first aspect, the present disclosure provides a method of determining the depth of a scene, the method comprising: capturing depth data of the scene with a depth sensor; capturing image data of the scene with a plurality of cameras; generating a point cloud

representative of the scene based on the depth data; identifying a region of the point cloud; generating depth data for the region based on the image data; and merging the depth data for the region with the depth data from the depth sensor to generate a merged point cloud representative of the scene.

**[0004b]** In a second aspect, the present disclosure provides a system for imaging a scene, comprising: multiple cameras arranged at different positions and orientations relative to the scene and configured to capture image data of the scene; a depth sensor configured to capture depth data about a depth of the scene; and a computing device communicatively coupled to the cameras and the depth sensor, wherein the computing device has a memory containing computer-executable instructions and a processor for executing the computer-executable instructions contained in the memory, and wherein the computer-executable instructions include instructions for receiving the image data from the cameras; receiving the depth data from the depth sensor; generating a point cloud representative of the scene based on the depth data; identifying a region of the point cloud; generating depth data for the region based on the image data; and merging the depth data for the region with the depth data from the depth sensor to generate a merged point cloud representative of the scene.

**[0004c]** In a third aspect, the present disclosure provides a method of determining the depth of a scene, the method comprising: capturing depth data of the scene with a depth sensor; generating a point cloud representative of the scene based on the depth data; identifying a region of the point cloud; registering the point cloud with three-dimensional (3D) medical scan data; and merging at least a portion of the 3D medical scan data with the depth data from the depth sensor to generate a merged point cloud representative of the scene.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0005]** Many aspects of the present disclosure can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale. Instead, emphasis is placed on clearly illustrating the principles of the present disclosure.