Fixed Camera Track for Rapid 3D Image Reconstruction

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Introduction: 3D scene reconstruction has traditionally been restricted to the fields of advanced robotics, but as technologies become cheaper, 3D cameras are finding their way into consumer electronics. Most notably, the next generation iPhone is rumored to include a rear-facing depth camera that could allow for Augmented Reality and greater photo capture options. One application of 3D scanning that has been readily explored is in the healthcare and clothing sectors, where body scanning has been proposed as a method to generate custom-fit clothing, braces, and 3D-printed casts. However, the 3D scanning technologies employed by these industries are large (typically the size of a small closet where the user stands inside a scanner) and expensive, and thus still require users to travel to a location to get scanned.

While 3D cameras are becoming ubiquitous, taking 3D scans with these cameras remains a challenge. 3D scanning with a camera on its own requires complex processing that is usually sent to the cloud for analysis. Coupling image data with movement data from inertial measurement units (IMUs) can make 3D reconstructions more accurate, but unlike true stereoscopic vision, IMUs measure velocities and accelerations rather than the relative position of two cameras. As a result of these limitations, 3D scanning with a 3D camera takes a considerable amount of time. For inanimate objects, this time is not an issue, but for scanning people, the long scan times are prone to errors from participant motion. Thus, a solution for rapid 3D scanning using consumer cameras is required.

Brief Project Description: One way to speed up 3D scanning is to take advantage of stereoscopic image principles. Here, if the distance and orientation between two cameras is known, the 3D location of points in the image can be identified. While we might only have one 3D camera, a similar principle can be utilized if we take two images with a single camera from known locations and orientations. Fixing a camera to a track can then reliably position a camera in a single location, which can greatly increase the speed at which scans are taken.

Expected Outcomes: The goal of this project is to design a fixed track for consumer 3D cameras to take images at fixed points along the track. We would also like teams to develop an interface with the 3D camera to take automatically take images at select points along the track, and augment current computer vision algorithms provided by available SDK to utilize known camera position and orientation information to stitch these images together into a more robust 3D reconstruction.

Resources Available from Customer: We are able to meet with students monthly to answer any questions and provide design feedback. We also can make available a 3D scanning camera and associated SDK for 3D reconstruction. We can also provide funds ($500) to cover prototyping materials. We also have some initial CAD designs for a fixed track and associated software from a previous iteration of this project that relied on 2D camera images rather than 3D depth images.