

3D Reconstruction on a Mobile Device

Summer Undergraduate Research Award

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1 Objectives

1. To get accurate position and orientation estimate based on readings of IMU (Inertial Measurement Unit) sensors in smartphones.
2. To use the camera feed in smartphones to enhance the position estimate based on visual tracking of objects.
3. To do sparse 3D reconstruction based on sensor fusion data and image processing.
4. To enhance the quality and efficiency of 3D reconstruction by adding more detailing and moving towards dense 3D reconstruction.
5. We will ultimately be fusing digital signal processing and computer vision based techniques that will enable us to perform near real time 3D reconstructions on mobile or hand-held devices.

2 Approach to the Project

1. Position and Orientation Estimation
 - (a) Get accelerometer data and orientation data at real time using the IMU sensors like: Accelerometer, Gyroscope, Gravity Sensor, Magnetometer present on the smart phone.
 - (b) The orientation data has been made much more accurate by infusing the higher frequency components from the gyroscope orientation after drift correction as the data output has a lot of noise infused.
 - (c) The displacement and orientation data is to be obtained from the camera feed on the device using visual tracking methods.
 - (d) A comparative study is to be done between the position estimates obtained by the 2 methods along with the ground truth and fusing the results to obtain an enhanced position and orientation estimate.
2. 3D Reconstruction
 - (a) Obtain sparse 3D reconstruction based on rotation and translation matrices obtained previously.
 - (b) Use tracking data from different tracking methods like “Good Features to Track” or “KL Tracker” for obtaining dense correspondance of points.
 - (c) Use guided matching by indirect computation of fundamental Matrix from estimated camera motion from sensors to further enrich the correspondences.
 - (d) Triangulate the dense correspondences and do a final global refinement.

3. Further Possibilities TODO: SOCCER.

- Releasing applications for Apple, Android and Windows platforms for near real time 3D reconstruction on the device itself.

4. Uses and Applications

- Using the device as an accurate measuring device.
- Doing real time dense 3D reconstructions on mobile phones and other handheld devices.
- Allowing user to generate a 3D printable file on his mobile device. As 3D printers are becoming cheaper and more common, this feature will reduce the need of the person to use a 3D scanner to be able to generate prototypes of objects. This will allow engineers and students to work more efficiently as they can generate copies of 3D objects easily.
- This can have applications in the field of archaeology. It can be used to generate replica of valuable and fragile objects for further studies.
- Localisation at tourist sites and providing real time directions to landmark locations.

3 Budget, Duration and Facilities

3.1 Budget

Rs. 25,000 will be needed to purchase an android smart phone having high quality sensors and a high resolution camera.

3.2 Duration

We will try to complete this project during the summer break ie. till the end of July, 2015.

3.3 Facilities

Facilities needed will be access to the Vision Lab.