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3D PANORAMA SCENE RECONSTRUCTION USING KINECT CAMERA

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ABSTRACT

In this paper, 3D panorama scene is constructed by moving around the Kinect Xbox 360 camera horizontally in indoor environment. The Kinect sensor is used because its price is cheaper than other devices but able to provide bountiful data for image processing purpose. By integrating the Kinect for windows with MATLAB, all computations, programming and processing of this project are done using the MATLAB itself. The overall system undergoes three major sectors which are the Image Acquisition Module, Image Processing and Analysis Module, and Result Processing and Displaying Module. The proposed system uses the latest "Point Cloud Processing" that was introduced in the MATLAB R2015a. Based on the result obtained, the system is able to reconstruct the 3D scene environment via offline and also real-time using the Graphical User Interface (GUI) for ease of use. The online system however, may need further improvement in terms of stabilization. Furthermore, the system is able to function with minimum lighting i.e. dark room or at night.

Keywords: 3D panorama, kinect, point cloud processing, image processing.

INTRODUCTION

3D mapping is expensively needed in many sectors and applications such as for search and rescue (SAR) mission with the major concern of navigations. In the case of fire rescue operation, a detailed map containing heat signal and overall view of the environment is essential to be translated to the fire fighters before heading into the scene. Nowadays, 3D environment is reconstructed with a combination of technique commonly known as SLAM [1] with the help of supporting devices such as mobile camera, LRF, laser scanner, or depth camera. One of the most important steps in SLAM is the 3D scene reconstruction. There are many support and application for 3D reconstruction such as for object recognition, path planning, navigation, localization and data association, etc. As such, there are two popular sensors used to acquire environment data for mapping problem in the market, which are the depth camera and the laser range finder (LRF). LRF takes a longer time to process due to the tilting time of laser scanner when generating 3D depth map. Furthermore, the LRF is an expensive item to use commercially. On the other hand, the most commonly used camera in 3D scene reconstruction is by using stereo camera. It is popular among many users due to its simple coding, software friendly and flexibility. Software friendly mentioned is in regard to the system have been widely used either in C, C++, VB, MATLAB and more. Flexibility of the stereo vision is because it is applicable to indoor and outdoor environment with less limitation compared to Kinect sensor mostly due to the absent of IR sensors. The shortcoming of using the stereo vision system is the extremely complicated pre-calibration. Since there are no IR sensors used and only the presence of RGB camera, extra measurement and calibration are needed to find the disparity formula to get the depth (distance) data. Therefore, correspondence matching issues will arise and requires higher cost as it involves a larger number of hardware [2]. The key point in this project is the 3D scene reconstruction is relied solely on the Microsoft Kinect sensors that consist of CMOS IR sensor for depth sensing, CMOS colour sensor for RGB imaging, a tilting motor and three-axis accelerometer. The low cost depth camera such as the Kinect's sensor image processing capabilities can reconstruct a real-time 3D scene faster and simpler than using the stereo camera [3]. However, Kinect's sensor is not quite as accurate as the LRF. Therefore, this project is inspired by the shortage of the both systems.

SCENE RECONSTRUCTION

The scene reconstruction will be going through three main steps; (1) Image acquisition module. This will be separated into two individual scan that is the depth camera and RGB camera. (2) Image processing and analysis module. In this step, the RGB data and depth information will undergo image alignment including point cloud transformation (3) Result Processing Module. Point cloud processing will then merge the results from the previous module and the 3D scene environment can be reconstructed. The above said steps are depicted in the Figure-1 below.

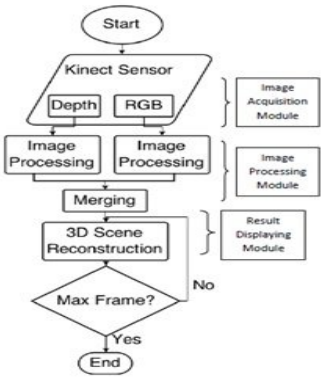

Figure-1. Three steps processing of scene construction.