國立交通大學
資訊工程學系

Lo mismo en chino

Intelligent Image Processing for Aerial 2-D Image Stitching

大　學　生　Andrés Ponce 彭思安

指 導 教 授　Maria Yuang 楊啟瑞

中華民國 109 年 12 月 27 日

1 Abstract

Intelligent Image Processing is one of the subtask of 5G-DIVE Autonomous Drone Scout (ADS) verticals. It aims to intelligently compute drone video stream in the edge to detect persons in need of help, and to provide stitched image of a disaster impacted area. 5G-DIVE project is a collaborative project between the EU and Taiwan to prove the technical merits and business value preposition of 5G technologies in ADS vertical pilot. In this research project, we worked on an improved Aerial 2D-ST solution that leverages the 5G-DIVE platform specifically the IESS to improve 2D-ST. In particular, AI techniques is used as a solution to improve on the existing 2D-ST solution to produce high-quality stitched image but without sacrificing for computation time.

2 Introduction

A panorama in visual art depicts a continuous scene or landscape [1]. The concept of panoramas in photoraphy has existed for centuries. In the middle of the 19^{th} century, landscapes were created by placing daguerrotypes side by side side by side [2]. Panorama images have been popularized in the last years due to their widespread inclusion in smartphones and digital cameras; for example, the iPhone5 introduced panoramic images in 2012 [3]. As processing power has grown, new and increasingly smart solutions have allowed better quality images to be stitched for pleasing results.

In digital photography, a panoramic image refers to a large composite image made of smaller images with overlapping areas. Computer software will look for the optimal way to combine the overlapping areas of the images such that the output panorama exhibits little or no visual artifacts. Image stitching has multiple uses other than recreative or artistic, producing a map of an area from overhead drone image [4], or for medical imaging applications.

3 Problem Description

The problem of focus here involves designing and implementing an image stitching pipeline that is robust yet has low latency. The input will be a series of images taken by a drone, and the output will be a single high-resolution panorama image.

An envisioned usage scenario would involve drones capturing video footage over an area impacted by some disaster. This footage is then to be transmitted to a server for stitching. Using the stitched images, a clearer representation of the impacted area should

Figure 1: Example of stitched image. However, some visual artifacts might still remain in the final image.

be visible, in case detecting persons in need of help or producing a clearer picture of the area was necessary.

4 Existing Literature

The original paper on image stitching [5] introduces a pipeline with several steps: feature matching, image matching, bundle adjustment, panorama straightening and blending. Many individual projects implement this pipeline and even some professional projects. OpenCV's image stitching module utilizes this pipeline to stitch multiple images together.

Next is a brief description of the pipeline according to the original paper:

1. **Image Matching**: In this stage we find the regions of interest in each image of the sequence. A region of interest, commonly called a feature, could represent an area of the image with large variations in pixel intensities. Once a feature is found, relevant information about it is stored in a k-d tree.

5 Resolution Method

6 System Design and Implementation

7 Result Analysis

8 Conclusions and Contributions

References

[1] (Mar. 22, 2018). "Panorama," [Online]. Available: `https://www.britannica.com/art/panorama-visual-arts`.

[2] O. H. Connection. (). "Cincinnati panorama of 1848," [Online]. Available: `https://www.ohiomemory.org/digital/collection/p267401coll36/id/4168`.

[3] T. Cheredar. (2012). "The iphone 5's badass camera: 40% faster photo capture, panorama mode, & more," [Online]. Available: `https://venturebeat.com/2012/09/12/iphone-5-camera/` (visited on 09/12/2012).

[4] P. Toffanin, *OpenDroneMap: The Missing Guide*, first. UAV4GEO, 2019.

[5] M. Brown and D. G. Lowe, "Automatic panoramic image stitching using invariant features," *International journal of computer vision*, vol. 74, no. 1, pp. 59–73, 2007.