Quadcopter Based Applications in Imaging

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for the degree of

Doctor of Philosophy

by

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under the guidance of

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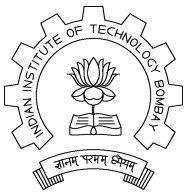

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Abstract

In today's world, digital imaging is being extensively used in almost all sectors. In some situations, it is quite difficult to take pictures from handheld camera. Low cost quadcopters such as Parrot's AR Drone may be used in such scenarios to take photos of an object which is otherwise out of reach of normal camera. There are two problems involved in it: first to track the given object and second to take "good" pictures of it. In my last APS we discussed about the first problem. Here, we will see how to take good pictures and use it for variouos applications.

One of the use case where we may use quadcopter for imaging is to capture a panaroma of big wall (or any such planar object). In such cases, it will be very tedious and tiring to use hand held camera. Secondly, if there are vacant spaces on a wall, it is challenging for existing mosaicing techniques as there will be little to no features to match input images. So, in our work, we focuses on a method to construct panoramas captured from a quadcopter, that consists of scenes with significant regions of vacant spaces.

We describe a framework that is able to handle this unique input by leveraging the availability of the inertial measurement unit (IMU) data from the quadcopter that is synchronized with the input images. We use the IMU data for two purposes: first to select images which can be stiched together. Second, in combination with coarse stereo reconstruction, we determine appropriate portions of the images to complete the panorama. We demonstrate the efficacy of our approach on a number of input sequences that cannot to be mosaiced by existing methods.

After using quadcopter for mosaicing of images, we thought of using it for some "survey" application. In recent times, there has been a sharp increase in dengue and malaria, especially in urban areas. One of the major reasons for this health hazard is the number of locations where one can find stagnant water. These locations are large breeding ground for fast multiplying mosquitoes, and other insects. Areas include traditionally uncovered gutters, and also terraces of high rise buildings, and shades above windows (popularly known as chhajja)– areas that are hard to reach and access. We propose the use of a quadcopter to inspect areas and identify stagnant water patches. Water being specular in nature tends to confound traditional image processing methods. Further the use of a non-traditional camera mounted on a quadcopter presents new challenges. We provide methods to get past such hurdles.

Keywords: Quadcopter, Panoramic Image Stitching, Stagnant Water Detection

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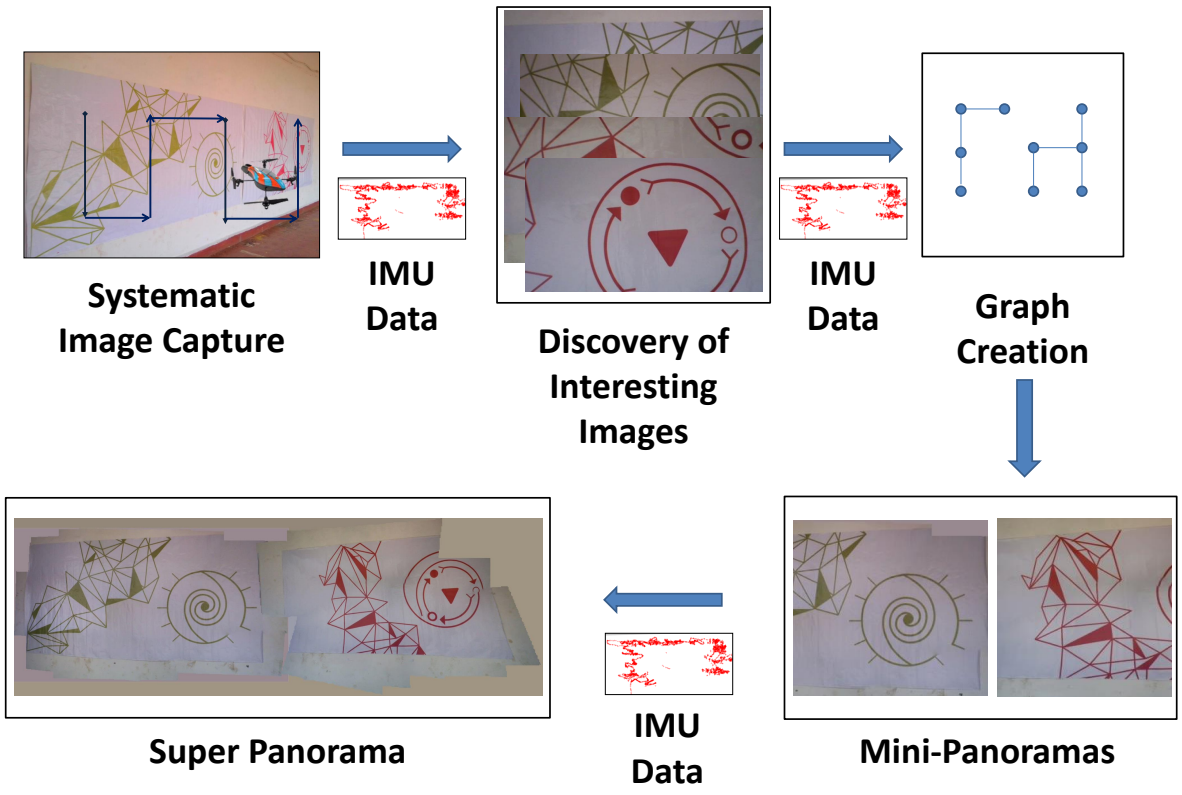

Figure 1: Overview: Input imagery is systematically acquired (top left) by a quadcopter. In the next step, interesting images are found by clustering the video into regions based on positional data. A graph is constructed using proximal images. For each connected component in a graph, standard stitching techniques are used to create mini-panoramas which are then joined together into super panorama again using IMU data.

3.1 Path Planning

3.2 Multi-planar Cases

4 Quadcopter-based Stagnant Water Identification

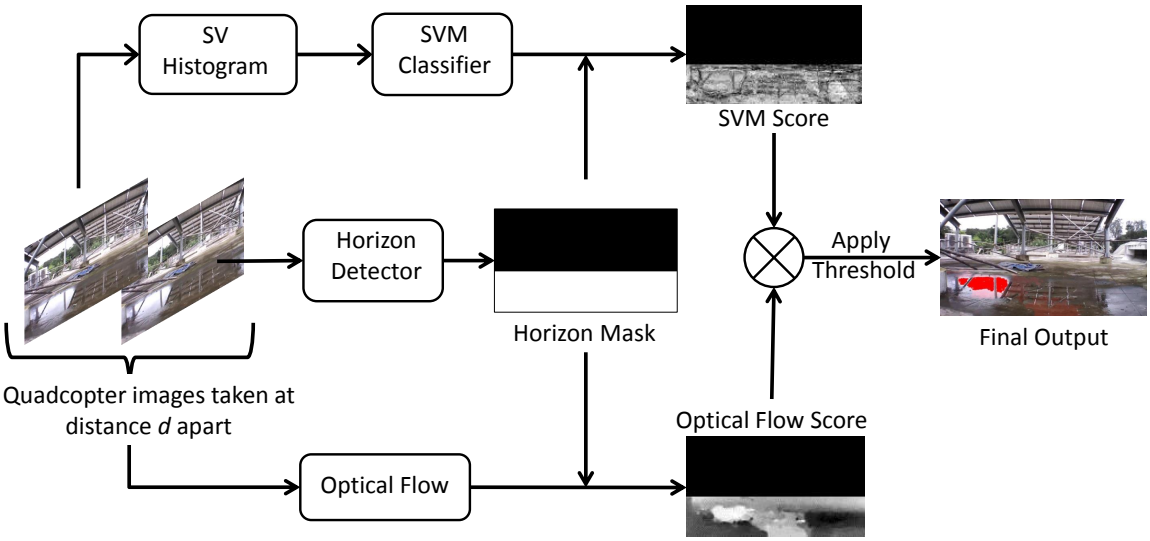

Figure 2: Overall architecture.