CCIT Report #867 September 2014

FRAME RATE REDUCTION OF DEPTH CAMERAS BY RGB-BASED DEPTH PREDICTION

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Abstract

Depth cameras are becoming widely used for facilitating fast and robust natural user interaction. But measuring depth can be high in power consumption mainly due to the active infrared illumination involved in the acquisition process, for both structured-light and time-of-flight technologies. It becomes a critical issue when the sensors are mounted on hand-held (mobile) devices, where power usage is of the essence.

A method is proposed to reduce the depth acquisition frame rate, possibly by factors of 2 or 3, thus saving considerable power. The compensation is done by calculating reliable depth estimations using a coupled color (RGB) camera working at full frame rate. These predictions, which are shown to perform outstandingly, create for the end user or application the perception of a depth sensor working at full frame rate. Quality measures based on skeleton extraction and depth inaccuracy are used to calculate the deviation from the ground truth.

1. Introduction

Depth sensors are becoming increasingly popular as a geometry sensing device to enable fast and robust natural user interface (NUI) applications [1,2] and other purposes, such as indoor 3D modeling [3]. The two main available technologies for computing depth, structured-light [4] and time-of-flight [5], use active infrared illumination, which consumes considerable power. This is a serious obstacle when trying to mount these sensors on mobile devices.

The main idea of this paper is to use an RGB camera coupled with the depth sensor (often there is already an RGB camera on such devices). The RGB camera is passive (does not use active illumination), and therefore operates at a considerably lower level of power consumption. We propose a method in which the information retrieved from the RGB camera can be utilized to allow a considerable reduction in depth frame rate acquisition, thus reducing the power consumption of the depth module.

An analysis of the RGB sequence is performed, whereby the motion is estimated using image processing algorithms such as optical flow methods.

1.1. Optical Flow

When attempting to estimate the motion of objects between frames, it is most common to generate the optical flow between them. The optical flow is defined as a piecewise