Application Group

A11-177

作品名稱

車用電子應用之H.264全景視訊接合與編碼系統

An H.264 Panoramic Video Stitching and Encoding System for Autotronics Applications

隊伍名稱

Jeannie妹妹舞步雄趴

Sister Jeannie's fashionable dance

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作品摘要

本次參賽作品為一種可應用於車用電子系統之創新H.264全景視訊接合與編碼系統，包含低記憶體頻寬H.264 視訊編碼器與即時全景影片接合技術，可以針對接合後之即時全景影片進行即時顯示與壓縮記錄。本作品主要應用於車用電子之行車駕駛輔助相關產品(如：行車記錄器等)，駕駛人可藉由觀看全景影片，避免行車死角可能造成的交通事故，並結合即時視訊編碼壓縮，降低行車記錄影片資料量，提供汽車駕駛人更安全的行車輔助與更全面的行車路況記錄。

本作品在全景影片接合技術之設計特色，主要目的是將安裝於汽車前方或後方的左右攝影機所拍攝之影片，即時接合成為一個廣角之全景影片。所提技術包含三個階段：在影像對齊階段，本作品對於各個來源影片的首張畫面，尋找其特徵點，並利用這些配對之特徵點進行即時影片接合處理。接下來在影像投影與扭曲階段，本作品以多維矩陣的表示方法，尋找兩來源之對應關係，然後接合成一個廣角全景影片。在影像補色階段，為了避免接合後影片中的移動物體通過接縫時之形狀扭曲，本作品提出動態影片接縫技術，計算出影片接合時之最佳接縫，並且進行色彩調整，提升接合後之全景影片畫質。

另一方面，本作品所提出之低記憶體頻寬H.264即時視訊編碼器同時支援了Baseline Profile與部分High Profile功能，針對接合完成之全景影片進行視訊編碼，此H.264編碼器具備低記憶體頻寬需求之設計特色，以支援全景視訊壓縮時所需的大量記憶體存取頻寬。本作品在Pre-load、in-loop deblocking filter (ILF)/entropy coding與prediction data buffer (PDB)/output frame buffer (OFB)/bitstream buffer等階段皆提出如MB-based與8x8 block-based的資料擺放方式等機制，能夠有效節省頻寬，相較於未採用所提技術之編碼器設計能有效降低約75%之外部記憶體資料頻寬，大幅提升系統執行效能。並且對於計算複雜的IME、FME以及intra coding階段提出可以大幅降低計算複雜度的演算法，如GOMB、ASR、AMS…等機制，使本作品可以更貼近即時應用的實現。

結合上述之即時全景影片接合技術與低記憶體頻寬H.264編碼器設計，提供汽車駕駛人更安全的行車輔助與更全面的行車路況記錄。

指導教授

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- 於1985年至1993年取得交通大學電子工程研究所博士。
- 1996年至1999年曾任聯合技術學院電子工程系系主任，並陸續擔任旺宏電子(1996~1999)、唯典科技(1999~2001)、凌華科技(2002~2004)顧問一職。2005年至2008年，擔任中正大學SOC研究中心主任，目前為中正大學資訊工程學系特聘教授兼系主任。
- 研究領域：包含 VLSI Design、Digital Signal Processing、Digital IP Design、SoC Design

ABSTRACT

This work proposed an innovation H.264 panoramic video stitching and encoding system for autotronics applications. In this work, we integrate a low memory bandwidth H.264 video encoding technology and a real-time panoramic video stitching technology for real-time display and recoding. By watching the panoramic video, the drivers can avoid the traffic accidents caused by blind corner. This work proposed a low memory bandwidth H.264 video encoding technology to encode the stitching video for reducing storage space. In this work, we can provide a safer environment for the drivers.

In the part of panoramic video stitching technology, the main purpose of the technology is to use the video captured by two cameras installed on car, and stitch them into a wide-angle panoramic video in real-time. The proposed technology contains several stages, including image alignment, image projection and warping, and image repairing. In the image alignment stage, the proposed system finds the feature points in the first frame of the individual video clip, and matches them for the next stage. In the image projection and warping stage, the proposed design extracts the feature pairs to find the relation of two source videos by using a homographic matrix with three by three dimensions. In the image repairing stage, in order to avoid distortion caused by moving objects, the design proposed a DOSF mechanism, calculating the best seam in the individual frame. Besides, the design adjusts the color and brightness of the panoramic video to enhance the video quality.

This work proposed a low memory bandwidth real-time H.264 video encoder which supports baseline profile and high profile for panoramic video. The memory bandwidth for the panoramic video encoding is large. To solve this problem, we proposed many mechanisms such as MB-based, 8x8 block-based data placement, etc. The proposed mechanisms can save memory bandwidth effectively in pre-load stage, in-loop deblocking filter (ILF) / entropy coding stage, and prediction data buffer (PDB)/ output frame buffer (OFB) / bitstream buffer stage. The simulation result shows that the design using proposed mechanisms can achieve 75% reduction in memory bandwidth. In IME, FME, and intra coding stage, the computation complexity is pretty high, so we proposed the low complexity algorithms such as GOMB, ASR, AMS, etc. The proposed improvements ensure that our work can be more suitable for the real-time applications.

The proposed work has three main features. The first is high flexibility for the input video. This work could process no matter what the source videos are captured with different angles or zooming effect. The second is quality scalable mechanism to improve the compression rate. The last is flexible system architecture. We have implemented the proposed work on two different platforms, including the PandaBoard platform and the FIE platform. Both of them can perform a good visual effect. As mentioned above, we trust that this work really can provide drivers a safer driving environment.