AI5-036

Automotive 3D Around View Monitoring

車用立體環景視訊系統

隊名 SoC 戰隊
隊長 李孟桑 / 雲林科技大學電子與光電工程研究所
隊員 李中然 / 雲林科技大學電子與光電工程研究所
劉騏輔 / 雲林科技大學電子與光電工程研究所
呂昱嫻 / 雲林科技大學電子與光電工程研究所

作品摘要

隨著科技的蓬勃發展以及生活水平的提升，車輛已經成為人類生活不可或缺的代步工具之一，但車輛的普及也導致現今的交通事故發生率總是居高不下。而其中許多交通事故發生的原因是因車體結構或後照鏡的視野侷限，造成內輪差、視覺死角等問題而不幸釀成意外發生。因此，為了降低這類交通事故再發生，近年眾多車廠也積極的發展汽車環景影像系統（Around View Monitoring，AVM），藉此提供駕駛者車外周圍資訊，讓駕駛者能透過影像資訊留意車輛周圍可能的危險情況，提早預防意外的發生。

AVM 是藉由架設於車上的前後及兩側位置的魚眼鏡頭，把所拍攝到的四邊影像經由演算法的轉換、拼接等方式，合成為一個具有俯視車輛四周環境的影像，藉以提供駕駛者車外資訊。目前市面上車廠所提供的 AVM 系統大多以俯視視角為主，可視範圍只有在車體向外延伸 1.5 ～ 3 公尺處，無法明確得知俯視範圍外的情況。故本團隊建立了一套車用立體環景視訊系統（Automotive 3D Around View Monitoring），透過建立周圍環境之立體模型，將攝像模組拍攝到的畫面資訊對應到立體模型上，實現 360 度的全車立體環景影像，改善原本 2D AVM 侷限於俯視視角的缺點，讓駕駛者能查看車身四周所有情況，解決車輛視覺死角的問題。

本作品利用四顆水平視角 190 度 CVBS 類比介面攝像模組，傳輸 SD 標準解析度畫面到瑞薩電子 R-CAR H2 開發板，再將畫面經過魚眼校正、透視投影轉換與四個畫面的影像縫合處理後，把原本平面的 360 度環景影像重新對應到車身周圍的立體模型。讓平面畫面經過本系統處理後成為 3D 立體的環景畫面，可視範圍由平面俯視的 1.5~3 公尺，變成垂直視角 90 度以上，水平視角 360 度的立體環景視訊系統。為了滿足系統執行期間，隨時更換視角時所需的大量浮點數運算，本系統利用 4 核 Cortex-A15 來執行多執行緒（Multi-thread）平行處理，使系統達到即時處理的要求。此項作品將會在今年第三季完成產品設計，並整合於現有技轉產品中進行實車測試，且多家國內汽車一級零件商已明確表達採用本技術之意向。

圖 1 / 鏡頭架設位置圖

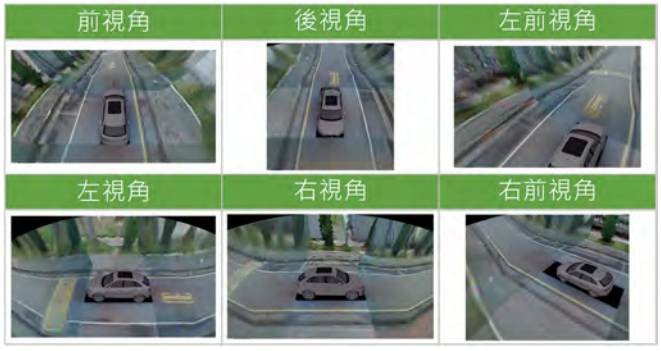

圖 2 / 系統成果圖 ，其中包含六種不同的視角畫面

指導教授　蘇慶龍 / 雲林科技大學電子工程系

交通大學電子工程研究所博士。於 2004 年起任教於雲林科技大學電子工程系，2013 年獲得國家發明獎，現在擔任雲林科技大學電子工程系副教授，以及典範計畫智慧節能創新產業中心副營運長。

研究領域

車用安全影像系統、多核心嵌入式運算、3D 視訊處理、數位視訊壓縮。

Abstract

As the technology flourishes and the standard of living is improved, cars have become one indispensable means of transport in human life. However, the popularity of cars results in high rates of traffic accidents. The car body structure and vision limitations of the rear view mirror lead to inner wheel difference and blind spots, so accidents happen. Therefore, to reduce these traffic accidents, many automakers actively develop the Around View Monitoring (AVM) Systems in recent years, which can provide the information around the car for drivers. Drivers can notice potentially dangerous situations with image information, so the accidents can be prevented.

The AVM applies the fisheye cameras set in the front, in the rear, and in both sides of cars. Through the conversion and splicing of algorithms, the recorded surrounding videos can be synthesized into a video that contain the overlooking view around the car, which can provide the surrounding information for drivers. Most commercially available AVM systems provided by automakers apply overlooking videos, and the visual range is only at 1.5-3m from the car body. Drivers cannot know the condition outside the overlooking view range clearly. Therefore, our team develops a 3D AVM system for automotive application. By establishing a 3D model of the surrounding environment, the recorded image information from the camera module can be presented on the 3D model, which realizes 360-degree whole-car 3D around view images and improves the 2D AVM disadvantage of limited overlooking view. Drivers can notice all conditions around the car without the problem of blind spots.

This project applies four CVBS analog interface camera modules with a horizontal perspective of 190 degrees, which transmit the images with SD standard resolution to the Renesas R-CAR H2 development board. After the processing of fisheye calibration, perspective transformation, and image stitching of four images, the original 2D 260-degree around view images can be presented on the 3D model of the conditions around the car. This system can convert the 2D images into 3D around view images, and the visual range can be extended from horizontal perspective of 1.5-3m to vertical perspective of at least 90 degrees, which is 3D around view monitoring system with 360-degree horizontal perspectives. To meet the requirements of a large number of floating-point arithmetic when switching perspectives, this system applies four-core Cortex-A15 to conduct multi-thread parallel processing, which can achieve real-time processing. The product design of this project will be completed in the third quarter of this year and integrated with current technology transfer products to conduct real car testing. In addition, several heads of auto parts suppliers have clearly expressed interest in adopting the proposed technology.

Fig.3 / Real Car Interior Layout