A18-120
智慧型自走輪椅
Autonomous Wheelchair

隊伍名稱　鋼鐵輪-輪椅界的超級英雄 Iron Wheel
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交通大學電子研究所博士，現為交通大學電機學院特聘教授兼副院長、晶片系統研究中心主任。曾任聯合大學電子工程學系講座教授、中正大學資訊工程學系合聘教授、交通大學電子工程學系電子研究所所長兼副系主任、智慧電子國家型計畫分項召集人、國科會微電子學門複審委員、國科會微電子學門整合型計畫主持人、國科會橋接計畫共同主持人、經濟部學界科專計畫分項計畫主持人。

研究領域

VLSI design, Digital Signal Processing, Visual Signal Processing, Digital IP design, SOC design。

作品摘要

隨著全球高齡化和殘疾人口上升，輪椅成為未來的剛需，市面上的手推及電動輪椅皆需要使用者擁有自主意識和雙手控制的條件下才能移動，為了讓醫院內的醫護人員工作時能更加方便、病人可以更輕鬆的移動，便誕生了智慧型自走輪椅的想法。

本作品「智慧型自走輪椅」是結合了區域定位、自動駕駛、智慧生活、物聯網與醫學應用的一個多功能自走輪椅，主要設定的目標使用者包含年長者、獨居老人、行動不便者、失明、視力模糊者，或剛出院體力尚未恢復之病人，希望這台輪椅不僅能協助他們毋須依靠他人便可自動行走，還可以減輕醫護人員及家庭成員對於照顧年邁老人、病人的負擔，而簡約、易懂的網頁介面可以讓照顧者隨時隨地掌握受照顧者的健康狀況、生理資訊，以及所在位置與行動軌跡等。

本作品結合智慧聯網功能及自動駕駛技術，是市面上少見的設計理念，絕大多數之室內載具僅具備其中一項功能。智慧聯網功能包含雲端資訊服務、血壓量測、吃藥提醒及家電控制，而將自動駕駛技術實現於輪椅上更是一大難題，考驗著定位、輪椅控制的相互配合及精準度，突發狀況之應變與處理，而同時我們為了能讓多數人負擔的起輪椅的售價，在成本考量上花費了許多心思，最後基於攝影機成本低廉且效果佳之原因，選擇了視覺感知的解決方案，但相對而言在視覺處理演算法上便會是另一大考驗，但我們善用平台之硬體特點，使用GPU加速，並盡可能簡化演算法之運算量，讓SLAM此大系統能在嵌入式平台上達到real-time之效能，且保持一定水準之精確度。我們希望透過這個輪椅可以為行動不方便的人帶來更多的快樂與驚喜，同時輪椅也可以讓病人的身體狀況被密切關注，雲端網頁服務也大幅降低照護者的負擔。

在未來我們希望本作品智慧型自駕輪椅可以適應多種場合，加上GPS並優化自動駕駛演算法以利在室外行走，進一步讓病人可以安全地到室外透氣與放鬆。此外，自動駕駛技術是目前各國努力的方向，也是未來趨勢，然而要將技術直接在車輛上實行有著較高的門檻與風險，本作品雖然已成功實現室內自動駕駛之功能，但我們更希望進一步將載具規模擴大，慢慢朝向自動駕駛車的目標邁進。

圖1. 智慧型自走輪椅成品照

Abstract

Because of global aging and rising of population with disabilities, wheel chair will be highly demanded in the near future. Wheel chair or electrical wheelchair nowadays requires the user to have self-consciousness and both hand to control the wheelchair. In order to let medical staff to work more conveniently, increase mobility of patient even with disabilities, the idea of a Smart Autonomous Wheelchair risen.

This wheel chair includes self-localization, self-driving, medication, Internet of Things and smart home. This wheelchair is designed for the elders who live alone, people with disabilities including vision and patient that haven recovered from surgeries. We hope that this wheel chair can increase their mobility and reduce stress of medical staff and families while taking care of elders and patients. This wheel chair have a friendly user interface. It also lets concerned people to know about the medical information, health information and current position of the user anytime.

This wheel chair also combines Internet of Things(IOT) and self-driving technology. Most indoor vehicle only consists of one of the function that this wheel chair can provide. IOT includes cloud service, blood pressure measurement, medication reminder and control of home electrical appliances. Applying self-driving technology on a wheel chair is challenging. To implement self-driving on wheel chair, self-localization and self-driving must work together and accurately. Unexpected situation and emergency response is also a major problem. In order to let our Smart Autonomous Wheel Chair more affordable, we spend a lot of time on the budget. We had chosen camera vision, which is relatively cheaper. Nevertheless, with computer vision solution, we face great problems on the algorithm. This is solved by using GPU acceleration, and reduction of complexity and computation costs of algorithm. We successfully implement Simultaneous Localization And Mapping (SLAM), on NVIDIA TX2 embedded system and achieved real-time with a great accuracy. We hope that with this wheel chair we can bring more happiness and surprise to people with disabilities, and their health situation can be monitored and reduce stress of guardian with the help of cloud service.

In the future, we hope that this Smart Autonomous Wheelchair can adapt to more situations, with the help of GPS and a better algorithm, and let patient to relax outdoors in a safe method. Self-driving is also a technology that many countries pay close attention to, it is the trend in the future. However, the thresholds and risks for implementing self-driving technology on vehicles are very high. Although we have successfully implemented self-driving indoors, we hope that we could further scale up our project and move towards the aim of self-driving vehicles.

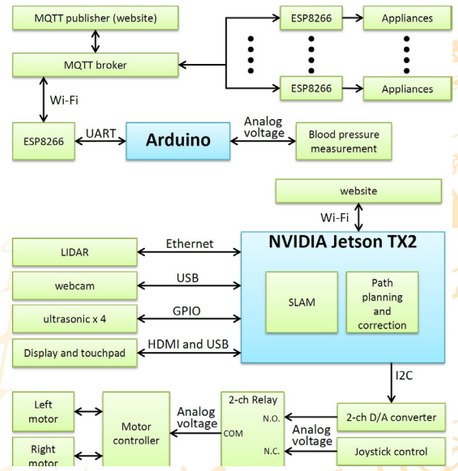

Fig.2 System architecture