基於波束成型技術之人工智慧人聲分離系統

An Artificial Intelligence Human Voice Separation System Based on Deep Beam-forming Techniques

APPLICATION GROUP A19-076 ·······

隊伍名稱 清聽
Pure-V

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研究領域
生醫系統整合、智慧聯網、醫療輔具科技、生醫穿戴式裝置、CT影像系統。

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研究領域
構音異常、音聲醫學、一般耳鼻喉、智慧聽診器、人工電子喉研發、AI 聲學分析。

世界衛生組織指出約4.6億人口有聽力損失的困擾，需要助聽器的協助，其中70歲以上的銀髮人口比例逐年上升；在美國就超過三分之二的 70 歲人口有聽力損失問題。粗估全球至少有 5 億人受聽力問題困擾，佔全球人口 8%，其市場潛力相當大。然而，助聽器科技發展數十年，在噪音涵蓋內的回聲、反饋音、風聲、機械音，都能逐漸透過工程技術加以解決，然而直到現在，仍有一個關鍵問題始終無法解決，就是在安靜的時候，單獨的目標講話，助聽器能放大的很清楚；當在有很多人講話的時候，就完全聽不清楚。世上充斥著各式各樣的聲音，人類的聽覺卻能出色地從雜亂的聲音中挑出自己想聽的話。例如在宴會中，眾人談論著不同的話題，我們卻能自然聽到其中有關自己的事，這就稱為「雞尾酒會效應」。目前，助聽器仍因降噪瓶頸而無法滿足患者對於「聽」的需求。

本作品「基於波束成型技術之人工智慧人聲分離系統」，是由臨床醫師所發現的關鍵需求，經團隊反覆討論與設計修正後，所共同開發的臨床需求產品。結合創新產品設計（IP）與人工智慧系統（AI）強化使用者收音品質，解決 傳統助聽器無法克服多重人類「語言噪聲」降噪（雞尾酒會效應 cocktail party effect）的技術瓶頸。而本團隊所提出的創新醫材便是針對該痛點提供一套完整解決方案，可立即取代現行使用的產品，解決當前臨床產品的缺口，強化聽障族群的生活品質。本產品基於「電腦視覺分析技術」、「波束成型微型硬體設計」與「即時語音降噪的深度神經網路設計」三大技術整合，實現人類的語音處理路徑。實驗結果顯示，這樣的系統設計經過實驗測試，隨著噪聲特性不同，其即時總降噪能力分佈在 6-10dB 的降噪效果，如圖所示。相比於目前市面上的助聽器產品，Pure V 能真正提供一套解決多重語音下助聽器的雞尾酒會效應限制，讓病患能聽得清楚、聽得舒服。若未來搭配語音辨識功能，本方案除了能提高其辨識度外，還能衍生出更多的智慧應用，如 AI 管家、智慧音箱、會議系統、人機互動、家庭娛樂互動、擴增實境等等，相當具有潛力。
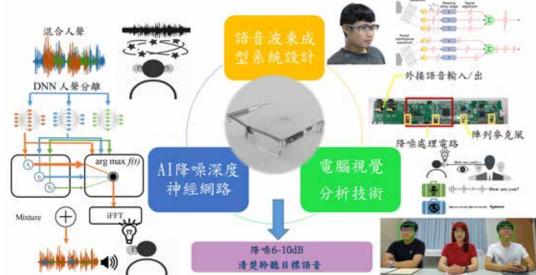

圖 1. 技術架構圖

According to World Health Organization, there are about 460 million people suffering from hearing loss and in the need of assistance of hearing aids, and among it, the proportion of senior population over 70 years old has been increasing year by year; in the US, more than 2/3 of the 70-year-old population are with hearing loss problems. It is estimated that at least 500 million people worldwide suffer from hearing problems, accounting for 8% of the global population,which brings a quite large market potential. Hearing aid technology has been developing for decades, so far the problem such as echo sound, feedback sound, wind sound, mechanical sound, has all been figured out by engineering technology, however, until now, there is still a key problem that cannot be solved,that is the so-called "Cocktail Party Effect." When people are in a quiet environment, the hearing aids can identify and amplify the specific target speech very clearly, but it wouldn't work when there are many people speaking at the same time. The world is full of all kinds of sounds, and our human hearing can exactly pick out what we want to hear. For example, in a banquet, everyone talks about different topics, but we can naturally hear those about ourselves. This is called the "Cocktail Party Effect". At present, hearing aids still cannot meet patients' demand for "listening" due to this bottleneck of noise cancellation.

The product" An Artificial Intelligence Human Voice Separation System Based on Deep Beam-forming Techniques " is a key demand discovered by clinicians and a joint work with our research team after several discussions and design revisions. Combined with Innovative Product design (IP) and Artificial Intelligence system (AI), this spectacle hearing aids can improve the audio quality and the technical bottleneck of multiple human sounds (the Cocktail Party Effect problem) which the previous hearing aids can't overcome. This innovative medical device, Pure V, proposed by our team provides a complete solution to the pain point, which would immediately replace the current products, enhance the inadequacy in the current clinical products, and promote the quality of life of the hearing-impaired groups. Pure V is based on the integration of the below 3 technologies, the "Computer Vision Analysis Technology", the "Adaptive Beam-forming System", and the "Deep Neural Network Design for Instant Noise-canceling" to realize the simulation of the human voice processing path. The experiment results show that through different noise characteristics, the total real-time noise cancellation is distributed in 6dB to10dB by this proposed system.

Fig.2 A new method of smart hearing solution