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A Fully Integrated Nose-on-a-Chip for Rapid Diagnosis of Ventilator-Associated Pneumonia

可用於呼吸器肺炎快速診斷的全整合晶片電子鼻

隊名 名稱怎麼想都不對
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作品摘要

般健康的人，肺部是處於無菌的環境。但由於進入加護病房，經過插管以及使用呼吸器，病患的下呼吸道就容易受到感染乃至引起肺炎，其比率可能高達 80% 以上！病菌在生長的時候，會有代謝物，其中也包括氣體在內。如果能在現行呼吸器的吐氣端管路上，加裝一個能夠「聞」的晶片，就有相當大的機會達到「即時」偵測「每位」使用呼吸器之病患的呼出氣體，有希望大幅降低在這個問題上所引起的死亡率。

「電子鼻晶片」，顧名思義，就是一個能夠「聞」的晶片。本團隊從奈米碳材為感測材質出發，偵測細菌代謝所產生的氣體，同時開發系統晶片。本晶片採用導電 - 聚合物形成氣體感測薄膜，當感測薄膜暴露氣體中，高分子聚合物部分膨脹而碳黑的部份不受影響，因此傳導路徑變長而造成電阻值的增加，感測此一電性變化即可做為氣體感測用，此材料兼具常溫操作、低功耗、高晶片相容性等特性、靈敏度、線性、迅速反應時間和能再現性。系統設計上，除了仰賴前端訊號的解析度和抗雜訊能力外，此晶片採用 32-bit RISC OpenRISC 處理器搭配數位運算處理單元，目標實現 0.5V 操作電壓，低功率消耗的系統晶片。

In Taiwan, thousands of people need to stay in intensive care unit (ICU) for all kinds of reason every day. Because there are many kinds of bacteria, a ventilated patient is easily infected, causing pneumonia, septicaemia shock, cardiopulmonary failure, and even death. The standard operating procedure (SOP) is to take chest X-ray, draw blood, and perform sputum culture, and then treat the patient with antibiotics of the speculated microorganisms, according to the doctor's experience. No one knows if the given antibiotics are suitable, because specimen culture needs five days, which may be the most crucial time for the patient to survive.

Since the microorganisms generate gases during metabolism, these gases could be very good candidates for early prediction and real-time detection of the microorganisms of pneumonia. If we can install a chip that can smell to the respirator, there is a very big chance to achieve real-time detection for every ventilated patient in the ICU and reduce the death rate due to this problem.

This project will proceed in both clinical inspection and engineering ways, and integrate these two together to test the proposed system in clinical trials. In clinical inspection, the exhaled gases of patients will be collected and analyzed, at the same time sputum culture will be performed to assure the microorganisms. This will establish a database of the relationship between the exhaled gases and the microorganisms. In engineering, we will proceed with researches on sensor, signal processing, algorithm, and system integration, to design, develop, and integrate a low-power, low-voltage electronic nose system-on-chip (SoC). The electronic nose SoC will be integrated to the expired circuit of the respirator for clinical trials to verify the feasibility of early prediction and real-time detection of the microorganisms of pneumonia.

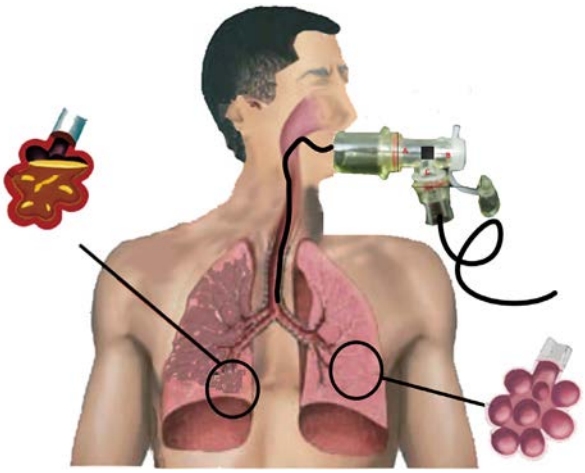

圖 1 / 目標應用情境：快速呼吸器肺炎診斷
System Block Target application scenario for rapid VAP diagnosis.