Blood Pressure Estimation Using PPG Signal

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開發工具：Python, Tensorflow
測試環境：Jupyter Notebook

一、簡介：

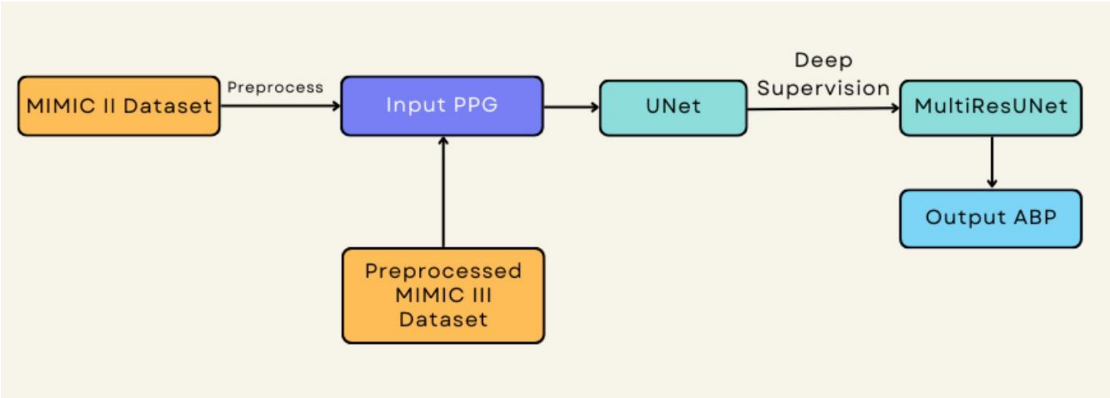
Cardiovascular diseases remain one of the leading causes of mortality, claiming countless lives annually. While continuous blood pressure monitoring is a promising solution, current methods often require invasive procedures, leading to complications and reliability issues. Non-invasive techniques, on the other hand, typically suffer from accuracy problems.

In response to these challenges, my project aims to develop a non-invasive method for estimating continuous arterial blood pressure (ABP) waveforms using Photoplethysmogram (PPG) signals. I leverage the power of deep learning to overcome the limitations of traditional approaches, which often rely on handcrafted features and ideally shaped PPG signals.

My method, PPG2ABP, employs a two-stage cascaded deep learning framework to estimate ABP waveforms from PPG signals, maintaining the integrity of shape, magnitude, and phase. Remarkably, this approach also excels in deriving Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), and Systolic Blood Pressure (SBP) values from the estimated ABP waveforms, outperforming existing methods. Moreover, the system meets the stringent criteria of the BHS (British Hypertension Society) and AAMI (Association for the Advancement of Medical Instrumentation) standards, achieving Grade A for both DBP and MAP.

For this endeavor, I utilize Python and Tensorflow, with Jupyter Notebook as the testing environment. By incorporating additional data, I aim to further enhance the accuracy and reliability of the PPG2ABP model.

以下為系統架構圖：



二、測試結果：

The training of the PPG2ABP model yielded impressive results, accurately estimating continuous arterial blood pressure (ABP) waveforms from Photoplethysmogram (PPG) signals. The model achieved a mean absolute error of 4.604 mmHg for the ABP waveform, maintaining the integrity of shape, magnitude, and phase.

In addition, the model excelled in calculating key blood pressure metrics. It achieved mean absolute errors of 3.449 ± 6.147 mmHg for Diastolic Blood Pressure (DBP), 2.310 ± 4.437 mmHg for Mean Arterial Pressure (MAP), and 5.727 ± 9.162 mmHg for Systolic Blood Pressure (SBP). These results not only surpass existing methods but also meet the stringent criteria of the British Hypertension Society (BHS) and the Association for the Advancement of Medical Instrumentation (AAMI), achieving Grade A for both DBP and MAP. This high level of accuracy and reliability underscores the model's potential for practical, non-invasive blood pressure monitoring.