

SaB10.11

DEVELOPMENT OF APPLICATION FOR BRIEF ASSESSMENT OF AUTONOMIC NERVOUS ACTIVITY IN HEALTHY PEOPLE

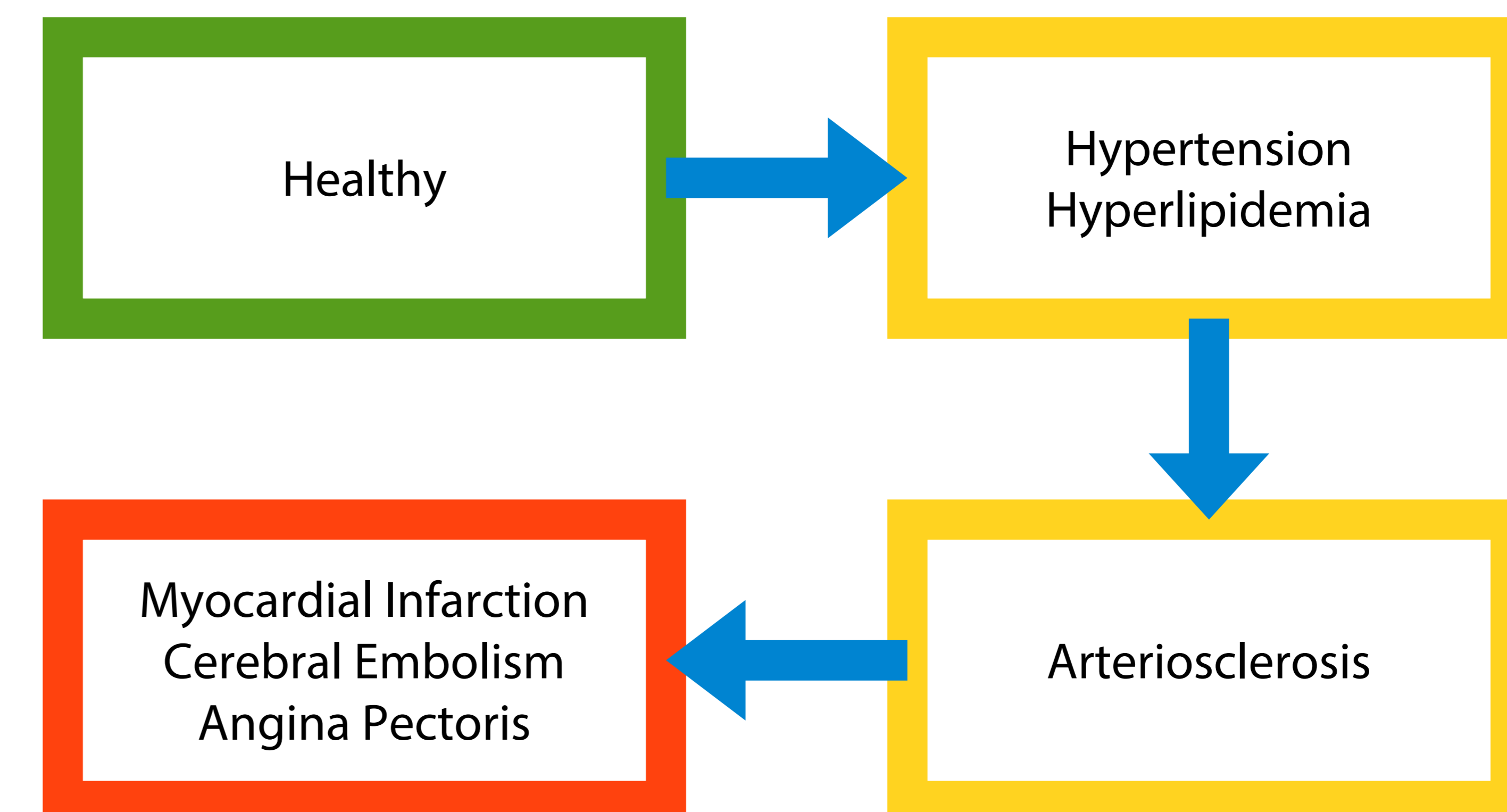
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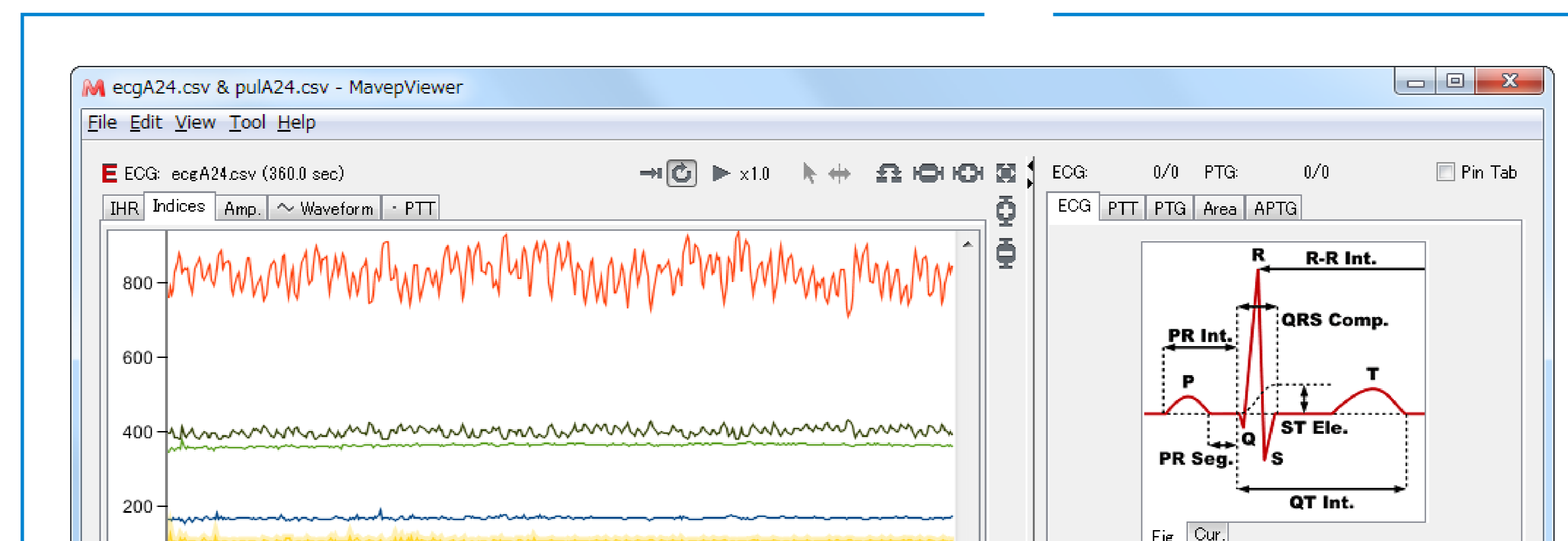
Recently in developed countries, chronic conditions represented by lifestyle-related diseases have become leading causes of death. We have focused on autonomic nervous activity (ANA) because it correlates with heart diseases [1], and consider both electrocardiogram (ECG) and plethysmogram (PTG) as the biological data, which reflects ANA. ECG and PTG obtained from healthy people provide several indices e.g. pulse transmission time [2, 3]. In this paper, we propose an application **Mavep** that analyzes ECG and PTG, and visualizes their indices; it offers a user interface (UI) for browsing the two data checking their relationship, for brief assessment of ANA. We implemented algorithms for analyzing raw ECG and PTG, and tailored UI that facilitates interaction between the biological data and users or doctors.



E ECG pane

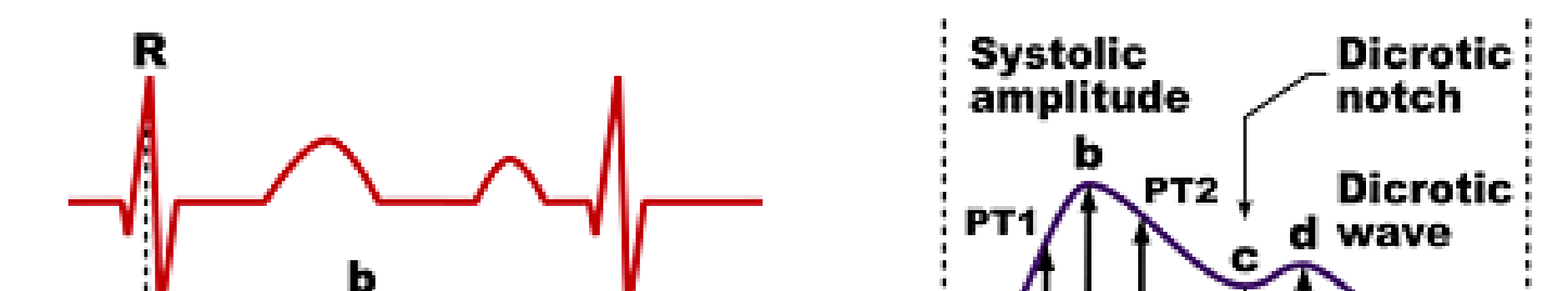
The ECG pane shows time-series charts of indices calculated from raw ECG data in each tab page respectively.

- Indices of ECG
 - PR Interval, PR Segment, QRS Complex, QT(c) Interval, R-R Interval, and ST Elevation
- Instantaneous heart rate (IHR)
- Voltage of feature points (P, Q, R, S, and T)
- Waveform



I Info pane

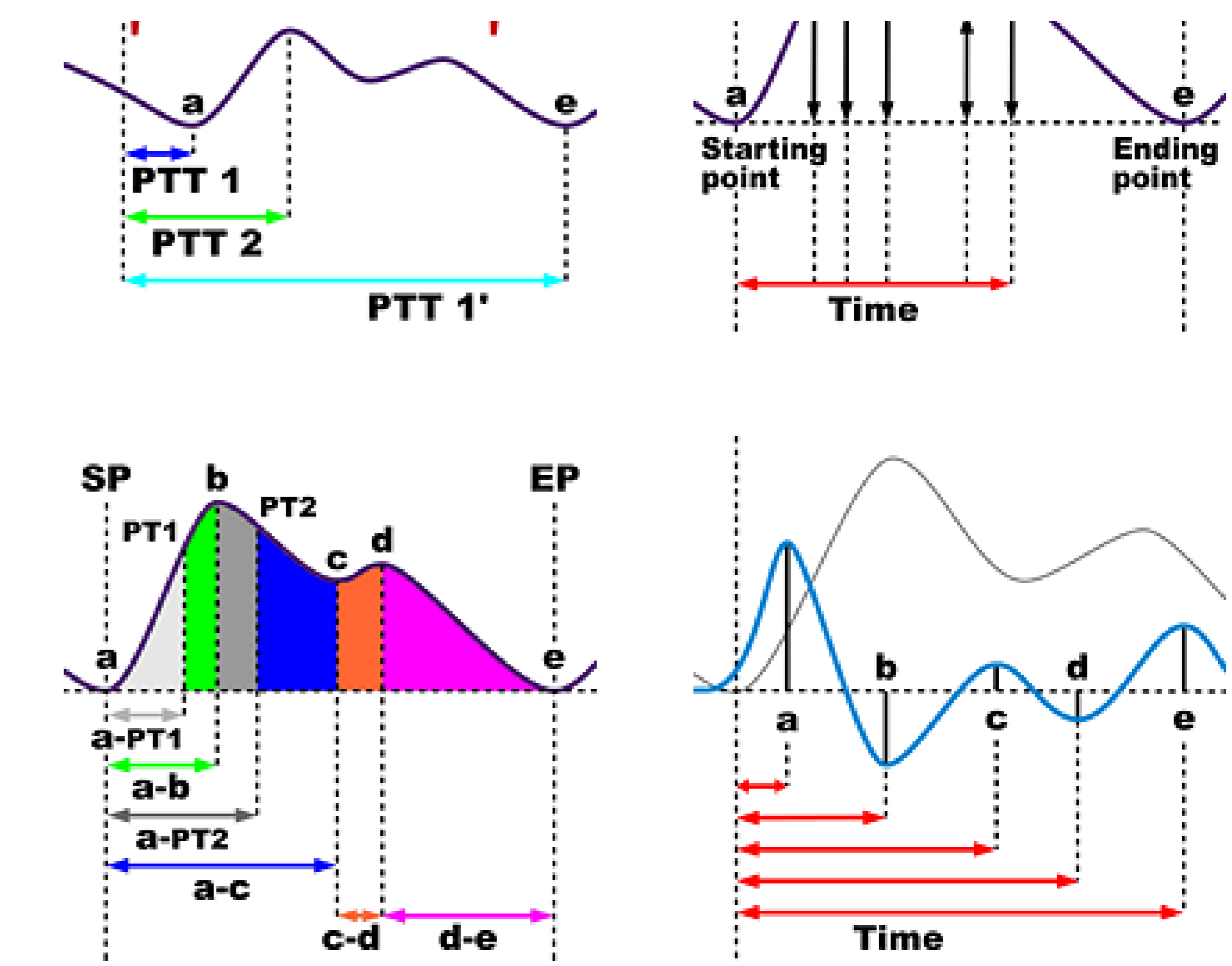
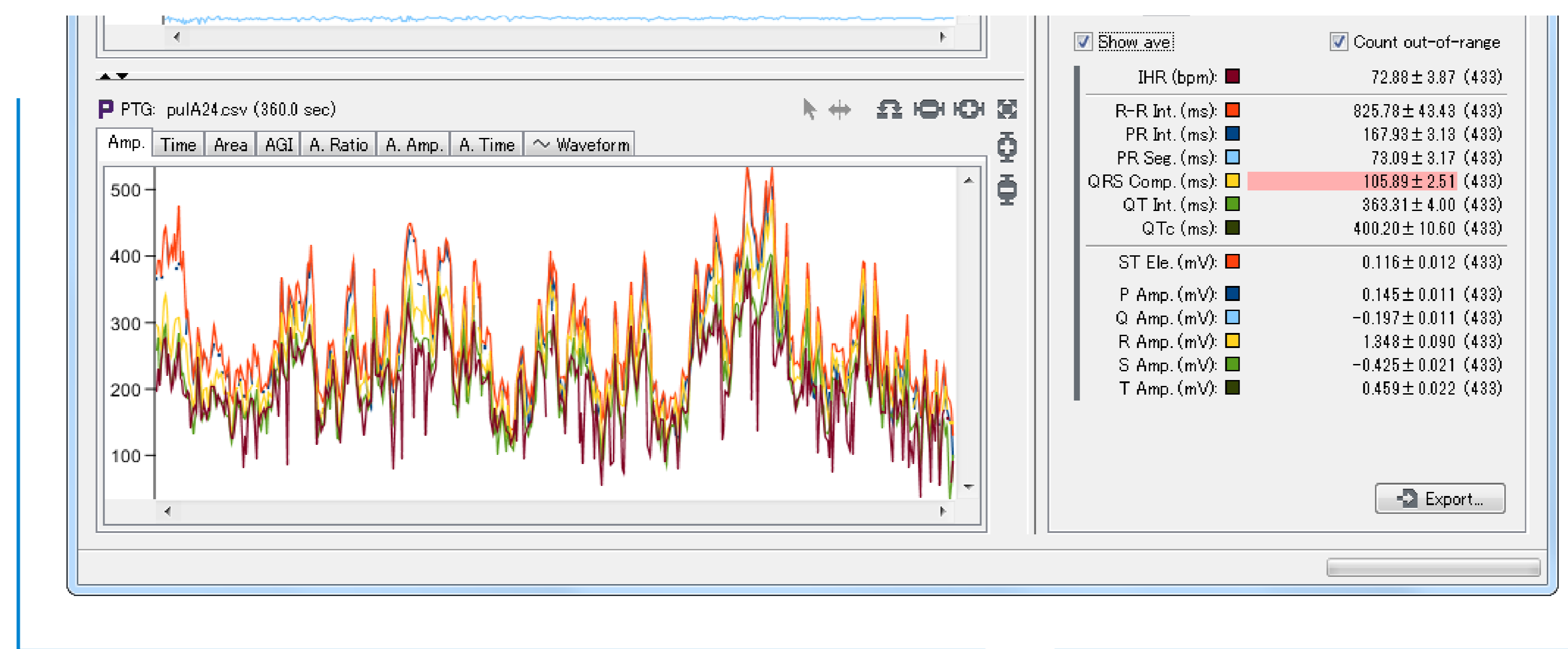
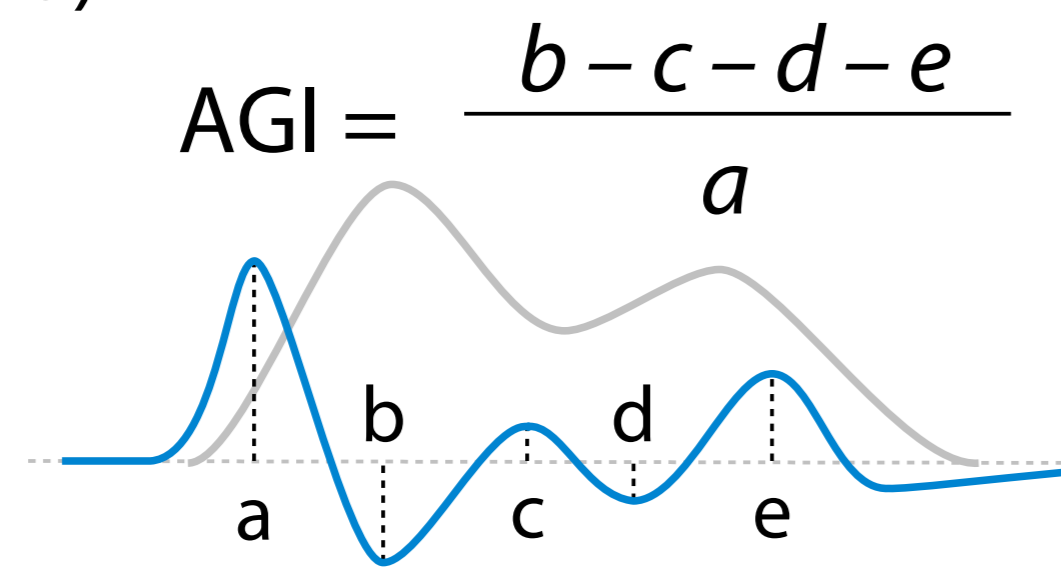
The information pane shows values of indices at the current position of cursors, which is black vertical line or light blue box especially in the waveform tabs.



P PTG pane

The PTG pane shows time-series charts of indices calculated from raw PTG data in each tab page respectively.

- Time and Height of feature points (a, b, c, d, and e)
- Area
- Acceleration PTG (Time, Amp., Ratio)
 - **Aging Index (AGI)**
- Waveform
- **Pulse Transmission Time (PTT)**



Usage

1. File Selection & Open
 - Users open CSV files of raw data of ECG and PTG
 - Mavep supports files in several column formats.

2. Automatic Data Analysis
 - Mavep detects feature points from each data of ECG and PTG by specific algorithms
 - It enables users to adjust positions of detected feature points.

3. Visualize Charts & Indices
 - Mavep shows each time series charts and averages and SD of each index.
 - It recalculates in response to users operations to enable/disable each pulse.

4. Assessment of Autonomic Nervous Activities
 - Users browse and evaluate each information.
 - Users can save it as CSV files for further analysis with external applications.

Usability

- In sync with each chart, users can change the view of the charts.
 - Zoom (Vertical, horizontal, fit chart)
 - Scroll (Scroll bars, dragging)
- Users can switch the current tab between the waveform tab and one of the other tab pages, keeping the cursor position.
- Available on Windows, Mac OS X, and Linux

We compared derived several indices of ECG and PTG from the three subjects with given averaged indices of healthy people and confirmed the values were within limits of normal. The points of our work is targeting healthy people and aiming at a portable system for brief assessment of health in future. In these days, high-performance smart phones are easily available, and measurement hardware for ECG and PTG might shrink and inexpensive. Developing the application in Java enables us to transplant it to smart phones, which adapt Android platform. Then, we try to propose a system for monitoring our health condition for both disease prevention and health promotion.

[1] T. Takagi, M. Ohishi, N. Ito, M. Kaibe, Y. Tatara, M. Terai, A. Shiota, N. Hayashi, H. Rakugi, and T. Ogihara, "Evaluation of morning blood pressure elevation and autonomic nervous activity in hypertensive patients using wavelet transform of heart rate variability," *Hypertension Research*, vol.29, no.12, pp.977–987, 2006.

[2] A. Lorscheid, D. de Lange, M. Hijmering, M. Cramer, and A. van de Wiel, "PR and QTc interval prolongation on the electrocardiogram after binge drinking in healthy individuals," *The Netherlands Journal of Medicine*, vol.63, no.2, pp.59–63, 2005.

[3] L.A. Bortolotto, J. Blacher, T. Kondo, K. Takazawa, and M.E. Safar, "Assessment of vascular aging and atherosclerosis in hypertensive subjects: Second derivative of photoplethysmogram versus pulse wave velocity," *American Journal of Hypertension*, vol.13, pp.165–171, 2000.