The GH-Method

Using Signal Processing Techniques to Predict PPG

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Abbreviations: T2D: type 2 diabetes; FPG: fasting plasma glucose; PPG: postprandial plasma glucose

1. BACKGROUND and AIM

The author has collected a complete set of PPG and lifestyle data for a period of 1,074 days with 3,222 meals (6/1/2015 - 5/10/2018). This paper discusses the methodology and accuracy of his developed PPG prediction model using signal processing techniques from electronics and communication engineering.

2. MATERIALS and METHODS

Due to his academic background in mathematics, physics, and engineering, he views these biomedical and lifestyle data as a collection of nonlinear signal waves. He applied signal processing to decompose this time-series measured PPG signal into multiple (> 10 lifestyle factors) single-sourced waveforms, examined each sub-signal carefully, and then re-integrated them into another nonlinear predicted PPG wave. Finally, he compared this predicted signal against the measured signal to calculate its linear accuracy and correlation. He further improved his model via a trial-and-error "curve-fitting" method.

3. RESULTS

The PPG's key influential factors' contribution on daily PPG, and their contribution margins are as follows:

Carbs/Sugar: 14.5 mg/dL, 38%
Post-meal Exercise: -15.8 mg/dL, 41%
Weather Temperature: +3.7 mg/dL, 10%
All Others: +1.9 mg/dL, 11%

During this period of 1,074 days, his averaged PPG values are:

Predicted: 119.82 mg/dL
Measured: 119.98 mg/dL
with 99.9% linear accuracy and a high correlation of 84% (Figures 1-6).

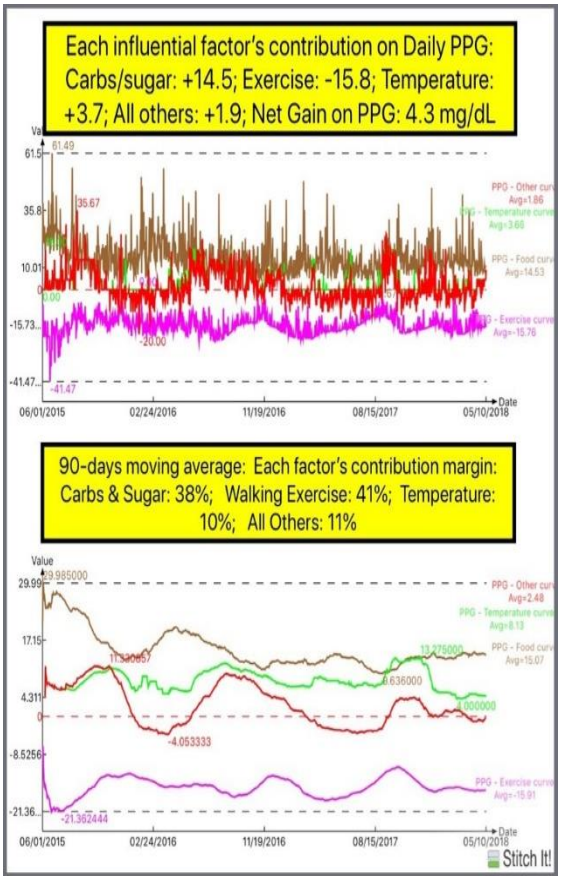

Figure 1: Decomposition of PPG into 4 key sub-waves.

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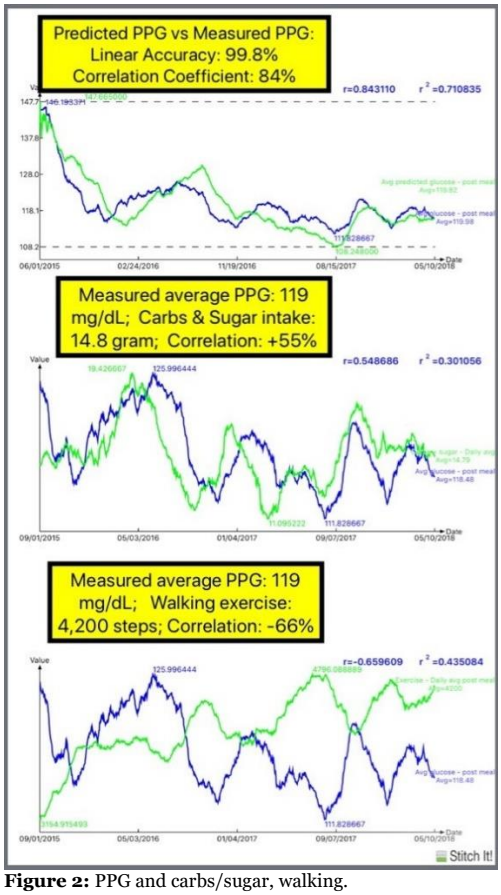

Figure 2: PPG and carbs/sugar, walking.

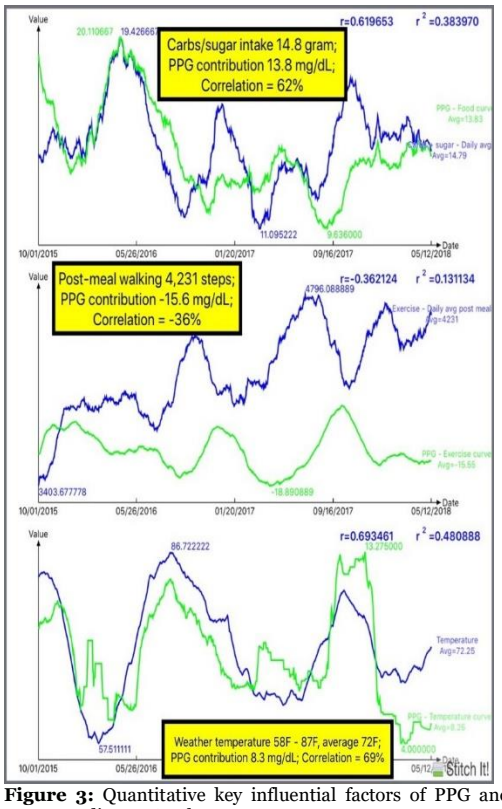

Figure 3: Quantitative key influential factors of PPG and their corresponding PPG sub-waves.

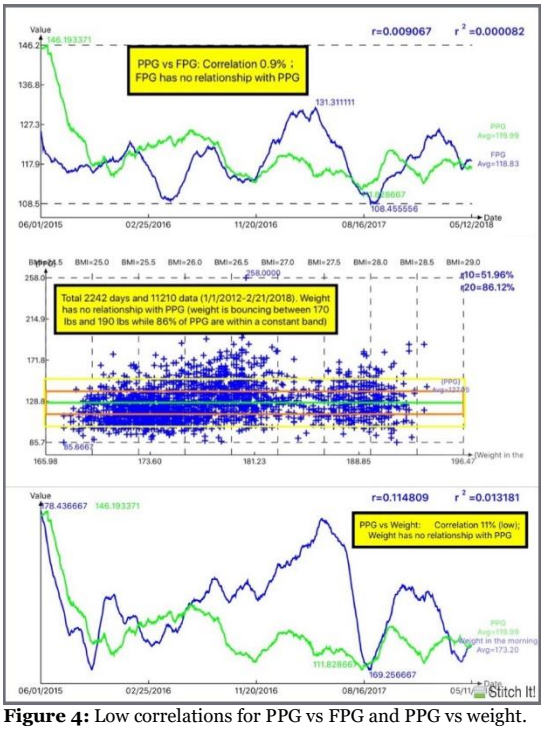

Figure 4: Low correlations for PPG vs FPG and PPG vs weight.

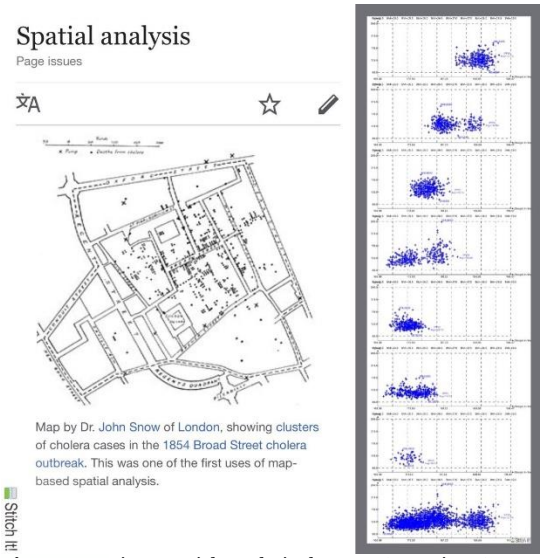

Figure 5: First spatial analysis by Dr. Snow in 1854 and PPG/weight spatial analysis.

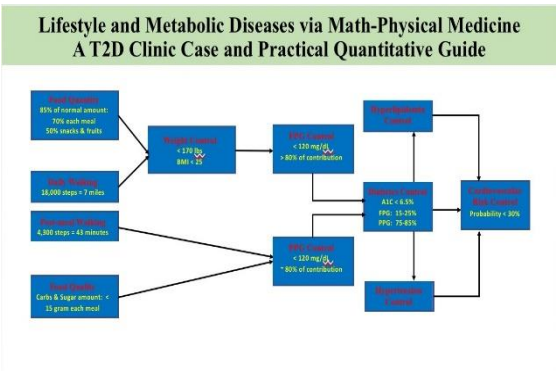

Figure 6: Flow diagram of practical quantitative guide for T2D control.

4. CONCLUSION

The quantitative results from the developed PPG prediction model reflect the accuracy and applicability for Type-2 diabetes control via a guided lifestyle management. The utilization of signal processing from electronics engineering and computer science is also proven quite effective for this investigation.