

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

ALIVECOR, INC.,
Patent Owner.

IPR2021-00971
Patent 10,595,731

**PETITIONER'S REPLY TO
PATENT OWNER'S RESPONSE**

LIST OF EXHIBITS

- APPLE-1001 U.S. Pat. No. 10,595,731 to Gopalakrishnan (“the ’731 patent”)
- APPLE-1002 Excerpts from the Prosecution History of the ’731 patent (“the Prosecution History”)
- APPLE-1003 Declaration of Dr. Bernard A. Chaitman
- APPLE-1004 PCT Patent Publication WO2012/140559 (“Shmueli”)
- APPLE-1005 U.S. Patent Publication 2014/0275840 (“Osorio”)
- APPLE-1006 Li Q, Clifford GD, “Signal quality and data fusion for false alarm reduction in the intensive care unit,” J Electrocardiol. 2012 Nov-Dec; 45(6):596-603 (“Li-2012”)
- APPLE-1007 U.S. Patent Publication 2008/0004904 (“Tran”)
- APPLE-1008 U.S. Patent Publication 2014/0107493 (“Yuen”)
- APPLE-1009 U.S. Patent Publication 2015/0119725 (“Martin”)
- APPLE-1010 U.S. Provisional Application No. 61/794,540 (“Osorio Provisional”)
- APPLE-1011 Lee J, Reyes BA, McManus DD, Mathias O, Chon KH. Atrial fibrillation detection using a smart phone. International Journal of Bioelectromagnetism, Vol. 15, No. 1, pp. 26 - 29, 2013 (“Lee 2013”)
- APPLE-1012 Tsipouras MG, Fotiadis DI. Automatic arrhythmia detection based on time and time-frequency analysis of heart rate variability. Comput Methods Programs Biomed. 2004 May; 74(2):95-108 (“Tsipouras 2004”)
- APPLE-1013 Lu S, Zhao H, Ju K, Shin K, Lee M, Shelley K, Chon KH. Can

photoplethysmography variability serve as an alternative approach to obtain heart rate variability information? J Clin Monit Comput. 2008 Feb; 22(1):23-9 (“Lu 2008”)

- APPLE-1014 Selvaraj N, Jaryal A, Santhosh J, Deepak KK, Anand S. Assessment of heart rate variability derived from finger-tip photoplethysmography as compared to electrocardiography. J Med Eng Technol. 2008 Nov-Dec; 32(6):479-84 (“Selvaraj 2008”)
- APPLE-1015 Lu G, Yang F, Taylor JA, Stein JF. A comparison of photoplethysmography and ECG recording to analyse heart rate variability in healthy subjects. J Med Eng Technol. 2009; 33(8):634-41 (“Lu 2009”)
- APPLE-1016 Suzuki T, Kameyama K, Tamura T. Development of the irregular pulse detection method in daily life using wearable photoplethysmographic sensor. Annu Int Conf IEEE Eng Med Biol Soc. 2009; 2009:6080-3 (“Suzuki 2009”)
- APPLE-1017 Reed MJ, Robertson CE, Addison PS. Heart rate variability measurements and the prediction of ventricular arrhythmias. QJM. 2005 Feb; 98(2):87-95 (“Reed 2005”)
- APPLE-1018 Schäfer A, Vagedes J. How accurate is pulse rate variability as an estimate of heart rate variability? A review on studies comparing photoplethysmographic technology with an electrocardiogram. Int J Cardiol. 2013 Jun 5; 166(1):15-29 (“Schafer 2013”)
- APPLE-1019 K. Douglas Wilkinson, “The Clinical Use of the Sphygmomanometer,” The British Medical Journal, 1189-90 (Dec. 27, 1924) (“Wilkinson”)
- APPLE-1020 U.S. Pat. No. 6,095,984 (“Amano”)
- APPLE-1021 B.K. Bootsma et. al, “Analysis of R-R intervals in patients with atrial fibrillation at rest and during exercise.” Circulation 1970; 41:783-794

- APPLE-1022 Frits L. Meijler and Fred H. M. Wittkamp, "Role of the Atrioventricular Node in Atrial Fibrillation" *Atrial Fibrillation: Mechanisms and Management*, 2nd ed. 1997 ("Meijler")
- APPLE-1023 Heart Diseases _ Definition of Heart Diseases by Merriam-Webster
- APPLE-1024 Acharya UR, Joseph KP, Kannathal N, Lim CM, Suri JS. Heart rate variability: a review. *Med Biol Eng Comput.* 2006 Dec; 44(12):1031-51 ("Acharya 2006")
- APPLE-1025 Saime Akdemir Akar, Sadik Kara, Fatma Latifoğlu, Vedat Bilgiç. Spectral analysis of photoplethysmographic signals: The importance of preprocessing. *Biomedical Signal Processing and Control*, 2013; 8(1):16-22 (Akar 2013)
- APPLE-1026 U.S. Provisional Application No. 61/915,113
- APPLE-1027 U.S. Provisional Application No. 61/953,616
- APPLE-1028 U.S. Provisional Application No. 61/969,019
- APPLE-1029 U.S. Provisional Application No. 61/970,551
- APPLE-1030 U.S. Provisional Application No. 62/014516
- APPLE-1031 U.S. Patent Publication No. 2012/0203491 ("Sun")
- APPLE-1032 U.S. Patent No. 9,808,206 ("Zhao")
- APPLE-1033 Kleiger RE, Stein PK, Bigger JT Jr. Heart rate variability: measurement and clinical utility. *Ann Noninvasive Electrocardiol.* 2005 Jan; 10(1):88-101 ("Kleiger 2005")
- APPLE-1034 Chen Z, Brown EN, Barbieri R. Characterizing nonlinear heartbeat dynamics within a point process framework. *IEEE Trans Biomed Eng.* 2010 Jun; 57(6):1335-47 ("Chen 2010")

- APPLE-1035 Karvonen, J., Vuorimaa, T. Heart Rate and Exercise Intensity During Sports Activities. *Sports Medicine* 5, 303–311 (1988) (“Karvonen 1988”)
- APPLE-1036 Yu C, Liu Z, McKenna T, Reisner AT, Reifman J. A method for automatic identification of reliable heart rates calculated from ECG and PPG waveforms. *J Am Med Inform Assoc.* 2006 May-Jun; 13(3):309-20 (“Yu 2006”)
- APPLE-1037 *AliveCor v Apple ITC Complaint Exhibit 11 (499 Infringement Chart)*
- APPLE-1038 Tavassoli, M, Ebadzadeh, MM, Malek H. (2012). Classification of cardiac arrhythmia with respect to ECG and HRV signal by genetic programming. *Canadian Journal on Artificial Intelligence, Machine Learning and Pattern Recognition.* 3. 1-13 (“TavassoLi-2012”)
- APPLE-1039 Asl BM, Setarehdan SK, Mohebbi M. Support vector machine-based arrhythmia classification using reduced features of heart rate variability signal. *Artif Intell Med.* 2008 Sep; 44(1):51-64 (“Asl 2008”)
- APPLE-1040 Yaghouby F., Ayatollahi A. (2009) An Arrhythmia Classification Method Based on Selected Features of Heart Rate Variability Signal and Support Vector Machine-Based Classifier. In: Dössel O., Schlegel W.C. (eds) *World Congress on Medical Physics and Biomedical Engineering, September 7 - 12, 2009, Munich, Germany. IFMBE Proceedings, vol 25/4.* Springer, Berlin, Heidelberg (“Yaghouby 2009”)
- APPLE-1041 Dallali, A, Kachouri, A, Samet, M. (2011). Integration of HRV, WT and neural networks for ECG arrhythmias classification. *ARPN Journal of Engineering and Applied Sciences.* VOL. 6. 74-82 (“Dallali 2011”)
- APPLE-1042 Sajda P. Machine learning for detection and diagnosis of disease. *Annu Rev Biomed Eng.* 2006; 8:537-65 (“Sajda 2006”)

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